DISCOVERY

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Notes of the Month

Twelve years' work at Ur-of-the-Chaldees will be brought to a successful close when the present season's excavations end. Dr. Leonard Woolley's latest report is thus received with mixed feelings—with the greatest satisfaction that the expedition has achieved its object beyond all expectations, and with regret that so thrilling a work of excavation will shortly be at an end. Dr. Woolley's discoveries have increased progressively in importance, and now range in time from Nebuchadnezzar back to the Flood. The Royal Tombs at Ur rival in magnificence the Tomb of Tutankhamen and far surpass it in cultural interest. The latest discovery of burials containing jars of stone—the material for which had been brought to a stoneless land from the remote parts of Mesopotamia and the Persian Gulf—calls up an impressive picture of the dignity and wealth of a city which long before the days of the Royal Tombs could organize the transport, the technical skill and the commercial machinery necessary to make a luxury into a commonplace. As time goes on it will become increasingly apparent that the initiation of the expedition to Ur in 1922 is one of the most important landmarks in the record of prehistoric archaeology.

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The aeroplane comes to the aid of science in many fields, and the latest instance of its use is an air attack on flying locusts in Rhodesia. This interesting experiment is being carried out by Mr. H. H. King, formerly chief entomologist to the Sudan Government, who proposes to discharge clouds of poison dust ahead of the flying swarms. Damage estimated at £1,500,000 a year is caused by locusts in tropical and sub-tropical Africa, and a really effective means of destruction has long been sought. In the course of laboratory tests, Mr. King has made the discovery that a spray of finely ground sodium arsenite is quickly fatal to the adult locust, and the most likely means of combatting migratory swarms is clearly from the air, especially in view of the immense area covered by flying locusts: swarms have been observed 1,200 miles from land. A de Havilland "Hercules" aeroplane is to be used, and the wings of the machine are specially fitted with dust discharging apparatus. It will be interesting to see whether the experiment is successful; if it is, it opens up possibilities of the first importance for the future and is bound to find a wide application. It is stated that the use of poisoned dust in this way offers no danger to human beings, livestock or crops, since the discharged cloud is quickly dissipated. The cost of the experiment in Rhodesia is estimated at £4,200 and the poison dust costs £50 a ton. If it is successful the results will amply justify the expenditure.

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Meanwhile the latest progress in the fight against insect pests in England and Wales is described in a report from the Ministry of Agriculture. Mention is made of experiments in the growing of pyrethrum, the flowers of which possess valuable toxic qualities. The value of this plant has long been recognized abroad, but it is only just beginning to be cultivated experimentally in this country. Special interest therefore attaches to an article on pyrethrum which will be contributed to *Discovery* by an expert next month. The author shows that, contrary to some opinions, this plant can be grown in many parts of England, and that the growing of crops on a large scale would prove to be an economic proposition. It is interesting to note that this view is confirmed by

experiments at the Rothamsted Experimental Station. The entry of foreign pests into this country through the agency of commerce is a serious problem, and the Ministry of Agriculture's report mentions particularly the apple fruit fly from the United States which causes such serious losses to growers. While insect pests are unavoidably imported, there is always the chance that beneficial species may also find their way into the country; and this is the case with the chalcid wasp which is capable of controlling the apple fruit fly. It is hoped that this useful parasite may prove able to flourish in the English climate.

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More has been written, and less is probably known, about the Maya civilization of Central America than about any other "vanished race." They have been claimed on the one hand as the originators of all human civilization, and they have been dismissed on the other hand as barbarous cannibals whose buildings were masses of rubble and whose writing was a primitive picture-script. The problem of estimating the true significance of Maya culture has often been attempted but never properly achieved. In *The Conquest of the Maya* (Jarrolds, 18*s*.), Mr. Leslie Mitchell has at last correlated information from the writings of the Conquistadores historians and has checked it with the results of archaeological excavation in recent times. The author's aim is to prove that the Maya culture, by its place in time and space, was a lost expedition of civilization, twisting and deforming the human mind as it twisted and deformed the human head. "For a thousand years it was the strangest litter of the discarded beliefs of the greater cults of the world."

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The Headmaster of Marlborough will propose the toast of "The London Boy" at the banquet of the East End Hostels Association, to be held in the Stationers' Hall on June 21st. Mr. Turner will be the sixth public school headmaster to undertake this toast, to which Mr. Lyon of Rugby spoke last year, and will thus maintain a tradition which is greatly valued by the Association. From the outset of its work in 1927, the Hostel has enjoyed the support of men distinguished in many walks of life, led by the Prince of Wales, who opened the Hostel and has since paid several visits. It provides a home in Stepney for eighty boys, who would otherwise be sleeping in public shelters and even the streets, as was actually the experience of some of those now in residence. A weekly charge is made out of wages—all the boys are in work—and no less than a third of the cost of this Hostel is paid by the boys themselves, whose self-chosen motto is "No Pains, No Gains." Other speakers on June 21st will include Lord Iliffe, Mr. John Drinkwater and the Rev. H. R. L. Sheppard. Tickets may be had on application to the Hostel's Secretary, Bouverie House, Fleet Street, E.C.4.

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The announcement by the Wild Plant Conservation Board that only four or five native species of plants have become extinct in England during the last two centuries may be regarded by some with complacency; but others recognize the urgency of the threat to our flora and the immediate need for action on a wide scale. There is evidence to show that nearly three hundred different kinds of native species have disappeared from some localities in one or more counties of England; and the dimunition of bluebells, anemones, primroses and ferns near the larger towns is increasingly obvious. This despoliation is usually regarded as an inevitable sacrifice to the needs of increasing population, but the destruction of wild plants round our towns is in many cases far greater than requirements warrant. The accumulative effect of individual thoughtlessness may well prove to be disastrous. The large increase in the pasque flower and the wild sea kale during the war, when human interference was greatly diminished, proves that the rarity of some of our native plants is avoidable. We therefore welcome an appeal just issued to county councils by the Wild Plant Conservation Board, which offers to send to individual councils a schedule of wild plants that ought to receive special protection in each county. We hope that local authorities will take advantage of this very helpful offer.

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A horticulturist's plea for the return of "the Elizabethan spirit of adventure" to the vegetable garden emphasizes our present lack of enterprise and experiment in this sphere. Science, with all her discoveries, seems to have neglected this promising field of activity. Mr. E. A. Bunyard recalls how many of our common vegetables were once regarded as harmful; and by the same token, no doubt, he now suggests that lilies and tulips are probably edible. The announcement has not so far been received with conspicuous enthusiasm, our distinguished contemporary *Nature* describing it as whimsical. But if tomatoes were once thought to be harmful and the potato was the subject of scorn; if the broad bean was forbidden and spinach called poison, there may not after all be so much whimsicality in Mr. Bunyard's suggestion. The return of the enterprise attributed to the Elizabethans would be warmly welcomed by those who feel that our vegetable gardens at present lack the spice of variety.

The Case for the Holy Shroud.

By Sir Frederic G. Kenyon, K.C.B., D.Litt., F.B.A.

No Biblical relic excels in interest the Holy Shroud of Turin, the authenticity of which has been the subject of dispute for centuries. Interest in the Shroud has lately been revived as a result of its re-examination by modern methods, and the case is ably presented in a new book. Sir Frederic Kenyon examines the evidence.

SINCE 1578 the Princes of the House of Savoy have been the owners of a relic venerated as the shroud in which the body of our Saviour was wrapped when it was taken down from the Cross and laid in the grave. Within the last generation it has not only been thrice exhibited, but has been submitted to photography and scientific examination. The results of the examinations in 1931 and 1933 have brought the question of its character and authenticity once more to the front, and they are set out in much detail and with scholarly moderation by Mgr. Barnes in a new book.*

Ancient Linen.

The shroud is a sheet of very ancient linen, some fourteen feet in length by three and a half in width. Its fabric is of a kind which can be paralleled in Egyptian linens at least as far back as the fourth century. On it are two impressions of a human figure, lying head to head, with the bodies stretching away in opposite directions. One impression shows the front view of the body, the other the back, and, if superimposed, they correspond exactly. The suggestion is that the body of our Lord was laid on one half of the sheet, and the other folded over it, just as represented in a painting by Giulio Clovio, reproduced on page 122, and that by some means its outlines imprinted themselves without distortion on the fabric. The shroud was certainly in Constantinople in 1150 ; it *may* have been brought thither from Jerusalem by the the Empress Eudocia in 438, but the evidence is not decisive. As a result of the sack of Constantinople by the Latin Crusaders in 1204 it was carried to France and placed in the cathedral of Besançon. When the cathedral was burnt in 1349 it seems to have been secured by Geoffrey de Charny, who built a chapel to receive it at Lirey. From that date its history is certain. It passed through various vicissitudes, and its authenticity, as we shall see, was disputed. In 1452 it was presented by Margaret de Charny to Louis, Duke of Savoy, ancestor of the King of Italy, who is now its owner. The Duke built a chapel for it at Chambery, on which Pope Sixtus IV. conferred the title of *La Sainte Chapelle*, and here in 1532 it suffered injury by fire, of which evident traces still remain. In 1578 it was transferred to Turin, the immediate motive being to allow St. Charles Borromeo, the saintly Archbishop of Milan, to fulfil a vow that he would walk barefoot to venerate it ; and in Turin it has remained to this day, being exhibited only at rare intervals.

Its modern history begins in 1898, when it was exhibited and (for the first time) photographed. The photographs were submitted to scientific investigation by two French professors, M. Vignon and M. Delage, the one a Catholic, the other an agnostic ; and a paper was read by the latter to the Académie des Sciences at Paris in 1902. Meanwhile, however, the eminent Christian archæologist, Canon Ulysse Chevalier, had declared emphatically against its authenticity, having discovered and printed what appears to be the draft of an appeal sent by the Bishop of Troyes about 1389 to the Avignon Pope Clement VII., denouncing the shroud, then at Lirey, as a forgery. His action was taken in the interest of a rival shroud, showing a frontal image only, in the possession of the cathedral of Besançon, who were certainly the owners of the authentic shroud before the fire of 1349 ; and he asserted that in the time of his predecessor of about that date the artist who had painted the Lirey shroud had been discovered and had admitted the fact. The opposition case was that Geoffrey de Charny had kept the original, and had given the Chapter of Besançon a copy of one half only ; and it may be added that in 1794 it was established that the Besançon shroud was only a printed copy, and it was destroyed with the consent of the clergy. Nevertheless Canon Chevalier maintained that the bishop's letter of 1389 was decisive proof that the Lirey shroud (which is incontestably that now at Turin) was itself a painted work of the fourteenth century.

The Scientists' Report.

The examination by the French scientists, however, led to conclusions of a totally different nature. They declared that the images were not paintings, but were the product of some natural agency, which had imprinted on the material images comparable in character to a photographic negative. When these negative images are themselves photographed, the result is a pair of positive images, showing a modelling and an

* *The Holy Shroud of Turin.* By ARTHUR STAPYLTON BARNES, Domestic Prelate to H.H. Pius XI. (Burns, Oates and Washbourne, 7*s.* 6*d.*).

anatomical perfection quite beyond the reach of a fourteenth century painter. What this natural agency was, they were not able definitely to say, but Professor Delage was prepared to affirm that the shroud bore representations of a human body, with the marks of scourging, the wounds in hands and feet and side, and the bleeding from the crown of thorns, exactly as described in the Gospels.

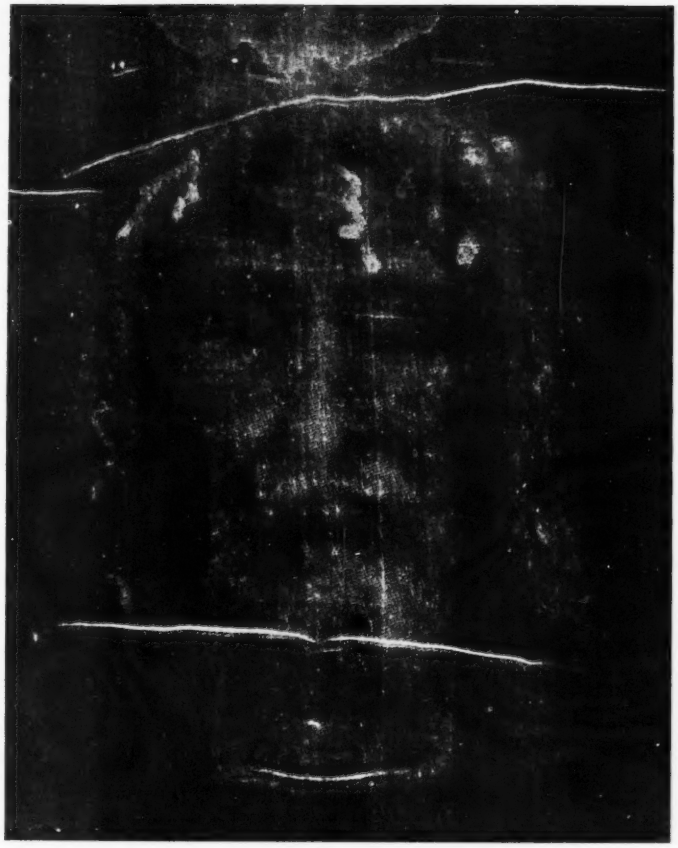
The conflict between the archæologist and the scientists remained for the time undecided; but now Mgr. Barnes has produced the results of the more detailed microscopic examination and the vastly improved photography which were possible in 1931 and 1933. These, as stated by him, entirely confirm the conclusions of Professor Delage. There is no trace of paint or any drawing material. The anatomical details have an accuracy totally unknown in France in the fourteenth century. The blood-marks are in accordance with the true circulation of the blood, then also quite unknown. The figures are reversed in light and shade, after the manner of a photographic negative, a process inconceivable at that date, and the result is infinitely removed from any portraiture of which that period was capable. They cannot have been produced by actual contact of the linen with the body; for to print rounded human limbs on the flat surface of the linen would have produced grotesquely distorted results. The suggestion is that the figures were produced by some emanations from the body, which left marks on the linen of greater or less intensity in proportion to the greater or less proximity of the linen to the various parts of the body. And it is maintained that every detail, which can be seen in the photographs reproduced in this volume, corresponds with the Gospel narrative.

Such is, in summary, the case which Mgr. Barnes puts before us. It is well and temperately expressed, with much detail which must be studied in the book itself. One would like to believe it. There are, however, gaps which must be filled up before full conviction can be achieved. The early history of the relic is far from complete. It is perhaps not so surprising that no mention is made of it in the earliest centuries; for the extant literature is not extensive, and little attention is paid in it to relics and sites which afterwards commanded so much interest. But one would have expected to hear more of it from the time of Constantine and Helena onwards. It is not even certain whether it was at Constantinople or Jerusalem between 438 and 1150; the evidence is slight and conflicting. But the vital problem concerns the images on the shroud themselves. Is it possible for such quasi-photographic impressions to be produced on linen (whether prepared with spices or otherwise) by effluvia from the human body? Surely it should not be beyond the resources of science to put this problem to the test. It is true that the test would not be quite simple. The condition of the body, tortured, wounded, covered with sweat, might make a material difference; but even so it might be possible

The XVI. century painting by Clovio, showing (above) angels holding the Shroud and (below) the way in which it was supposedly used to cover our Lord's body when taken from the Cross.

to come near enough to the required conditions to ascertain whether *any* impression can be made by a human body immediately after death. We have learnt so much of late years about X-rays and similar natural operations that no one without the necessary scientific equipment is entitled to affirm that it is impossible; it must be left for scientists to investigate and decide.

On the other hand it has to be borne in mind that the images as they appear to-day have to be accounted for. If they were not produced in the way suggested, how were they produced? There is no possibility that they are of modern manufacture; the picture by Giulio Clovio, which includes a representation of the shroud as well as a reconstruction of the scene of the Deposition, is sufficient proof of this. And the figure, as it appears in the photographs, is no work of a mediæval painter. The character of the face, the anatomical structure, the details of the wounds and the blood caused by them, are quite alien from anything we know of early art. If science can only say that the natural operation is possible, then there is no reason why we should not believe.



The face of Jesus as it appears upon the Shroud. This is the untouched negative of a photograph. (*Illustrations reproduced by courtesy of Burns, Oates and Washbourne.*)

It should be added that the face, as it appears in the photographs, is such as Christians could readily accept. It has manly beauty, dignity and pathos, and corresponds sufficiently with the traditional portrait (this in itself is an argument that can be turned either way, and by itself is no additional proof of authenticity). Mgr. Barnes believes that it is actually the origin of the traditional portrait, artists having seen the shroud at Constantinople and copied it; but this is no more than a conjecture, and here the matter must be left.

One or two details seem open to criticism. Mgr. Barnes, in dealing with the Gospel narratives, lays stress on the detail that St. John and St. Peter, when they first saw the empty tomb, saw the bandages which had bound the shroud to the body, lying, separately, "still not undone, but in their coils," a thing impossible by human agency, since no one could remove the body without undoing the bandages. The point has no importance that I can see, but in fact St. John does not say that the bandages were still fastened in their coils. It may also be objected that St. Louis of France did not lead the Second Crusade (p. 52).

WHAT is the origin of cosmic rays? Study of this fascinating subject began thirty years ago with the discovery that clean, dry air at sea level was a slight conductor of electricity. The subject has now grown into one of the most important branches of physics and of astronomy. Addressing the Royal Institution, Professor P. M. S. Blackett, F.R.S., said that, whatever the final explanation for the rays was found to be, their origin would probably be of immense astronomical importance. It appears from investigations that the earth is being bombarded by streams of positrons and electrons of very great energy. They come continually from outside our galactic system, but from where, or how they are produced, no one knows.

Using the Energy of Atoms in Industry.

By John Thomson, D.Sc.

Lecturer in Natural Philosophy at the University of Glasgow.

One of the most engaging problems in natural science is the possibility of using the energy contained in atoms for commercial purposes. If the atomic energy of coal could be used to drive locomotives, a pound would take the place of one and a half million tons used at present. Apparatus which may be used for this purpose in the future is here proposed.

THE experiments at Cambridge on the transmutation of the elements have already been described in *Discovery* by Lord Rutherford, and their great importance to theoretical physics has been explained. The fact that these investigations have also indirectly demonstrated the possibility of liberating some of the internal energy of the atom again directs attention to the possibility of using this energy in industry.

Most people are now aware of the existence of so-called "atomic energy." It is to the genius of Einstein that the conception is originally due; but many facts discovered during the past twenty years have led physicists to believe, independently of the theory of relativity, that each piece of matter in the universe has, by virtue of its mass, a certain quantity of energy. In effect this belief amounts to a statement that matter is itself a rather particular form of energy, for, if we could destroy a piece of matter completely—take from it the quality which identifies it as matter, namely its mass—we would undoubtedly liberate an equivalent quantity of energy. This fact may appear to be of little interest to those who are not immediately concerned with the structure of the atom; but when calculations are made of the amount of energy which might be obtained from a given mass of matter, the figures are so astonishing that the question of the possibility of applying this tremendous power to industry becomes of wide general interest.

Energy from Coal.

Let us take a pound of coal as an example of an ordinary source of power. On account of its chemical constitution this substance burns when it is ignited in air, and in so doing it liberates heat, a useful form of energy. From a pound of reasonably good coal one may expect to obtain about 12,000 British thermal units, a number which evaluates for practical purposes its chemical energy. What now of its atomic energy? If we could utilize all the internal energy of all the atoms in a pound of coal by transforming it to heat, how many British thermal units would we obtain? The answer is so large as to be almost incomprehensible; yet about its truth there can be no reasonable doubt. The atomic energy contained in one pound of coal is equivalent to forty million million British thermal units. Another and perhaps a more suggestive way of making the comparison is to say that if we could use the atomic energy contained in coal for driving our engines, one pound of it would go as far as one and half a million tons go at present.

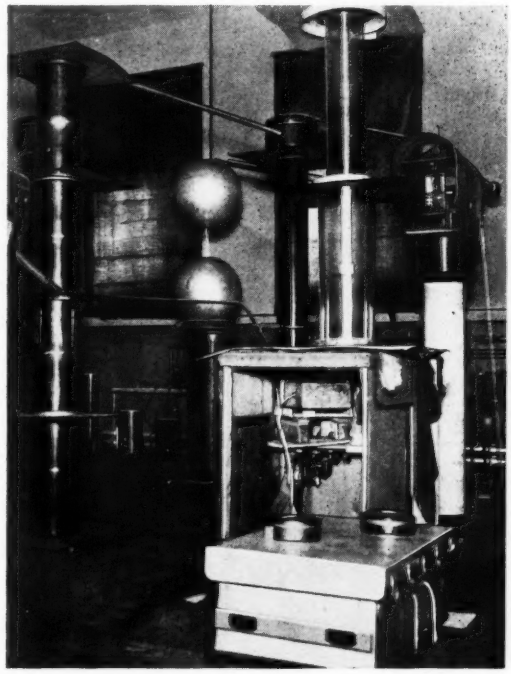
Limitless Power.

As Lord Rutherford has already pointed out, there is no immediate danger of atomic energy becoming available for practical purposes. The word "danger" has been purposely used, for it is surely obvious that in the hands of the wrong people atomic energy would be a most unfortunate possession; the magnitude of the quantities involved makes it something quite outside normal human experience. But in spite of this, and in spite of the fact that the experiments at Cambridge do not make atomic energy a practical source of power, it is quite probable that in the future we shall learn to master and make use of this almost limitless storehouse. Let us therefore consider in more detail the mechanism by which the atom may be made to give up its fire.

There are two quite distinct problems involved. First, and most important, physicists must discover a means of *liberating* the atomic energy in any form. This has already been done at Cambridge, but as we know the efficiency of the method was small. To recapitulate briefly, the experiment consisted in firing charged atoms of hydrogen (protons) into a target consisting of a light metal. The majority of the atomic "bullets" missed their target completely; they passed through the interstices between the metallic atoms. But occasionally a proton came sufficiently near to the nucleus of an atom of the metal to upset the delicate internal equilibrium of the latter, and the result was the disintegration of the atom and the liberation of energy. Taking no account of the "misses" in this target practice, each atomic disintegration gave rise to particles, the energies of which were very much greater than that of the "bullet" particle. So that where a direct hit was obtained energy was "manufactured." But if the misses are taken into account, the result is very different. Since the misses greatly outnumbered the hits, energy was continually being lost; and it is this which makes

the method totally unsuitable for the practical liberation of energy.

Hence some other mode of attack must be found, and in the opinion of the writer the most likely one has not yet been tried. To make the "bullet" particles effective, Lord Rutherford and his assistants found it necessary to use protons travelling with a very high velocity. This was obtained by accelerating the charged particles in an electric field, and their velocity was ultimately equivalent to an electric potential of about 200,000 volts. It is known that the efficiency of the impacts is greater at higher voltages, but it is a matter of some considerable difficulty to obtain a discharge tube which will withstand such a high electric pressure; in any case such "bullet" particles, regardless of their velocity, are not sufficiently effective to make the experimental arrangement commercially practicable. If, however, electro-magnetic radiation of sufficiently high frequency could be generated, the bombardment of the metallic atoms by its pulses would undoubtedly be a more efficient means of producing disintegration. Photons (quanta or packets of electro-magnetic energy) are in general more efficient in bringing about atomic changes than particles of corresponding energy. On the other hand it is correspondingly more difficult (at the present time) to produce this electro-magnetic radiation of high frequency.



The high voltage generator for accelerating protons used in experiments at Cambridge.

It seems to the writer that any serious attempt to transmute the elements with a resultant net gain in energy must have its origin in the means of producing very high frequency radiation. That such radiation already exists in nature is highly probable, for the latest evidence indicates that the so-called "cosmic radiation" is of this type. What is required therefore is a means of producing in the laboratory radiation of the gamma-ray type, but of very much shorter wavelength. Most experimental physicists will say that this is an almost impossible task, involving as it does all the difficulties inherent in the production of the high-speed particles used by Lord Rutherford in his experiments. But the difficulties are all of technique, and already there are signs that the most important of these have been overcome in American laboratories, where it has been found possible to obtain particles travelling with a speed equivalent to an electric pressure of two million volts. In short, the problem is difficult but the solution is only a matter of time.

Having developed the necessary technique for generating this high frequency radiation, the physicist's next step would be to determine whether or not a particular type of atom responded violently to radiation of a certain frequency. This would be done by a technical process which need not here be described. The effect would probably be to cause disturbances of such magnitude in the atomic nucleus that a cataclysmic change in the nature of the substance would take place with the liberation of energy.

It must not be imagined, however, that anything in the nature of an uncontrollable explosion would follow the atomic disruptions thus brought about. Many people have pictured the liberation of atomic energy as something which would be highly dangerous to the world; a kind of earthquake in which all matter would change spontaneously, emitting death-dealing rays in the process. Nothing could be further from the rational expectations of physicists. The problem will be of the opposite type: how to maintain the atomic disintegrations rather than how to quench them. The process when it is perfected will be as easily controlled as the generation of heat by a coal fire, and we shall never have so much energy emitted per second that we cannot store it away conveniently.

The second problem involved in the utilization of the energy of matter is of an entirely different type. Having liberated the energy it is also necessary, before we can use it, to transform it to one of the more usual

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forms of power. We must, in other words, be able to store the energy in an electrical form or in the form of heat. We must also be able to do this in a very limited volume of space, if the resulting electric voltage or temperature is to be high enough to be of value. It is this second difficulty—quite as difficult as the first—which is almost always neglected by those who write about new sources of power.

To understand the nature of the problem it is necessary to be quite clear as to what exactly results from the transmutation or disintegration of an atom. It is necessary here to enter into some technical details which, however, will be easily followed. In the Cambridge experiments, where one of the bullet particles made a direct hit on a metallic atom, the latter was forced to eject from its nucleus one or more particles moving initially with a very large velocity. Now a particle of mass m moving with a speed v has energy which is known as kinetic and is numerically equal to $\frac{1}{2} mv^2$. It is this energy which we have liberated from the atom and which we wish to collect and use. The problem is therefore very much akin to that of trying to utilize the energy of a stream of bullets from a machine gun to run a train! If the particles are allowed to move away from the parent atom through a gas (the atmosphere, let us say) they very gradually lose their speed and hence their energy by collisions with gas atoms; but this occurs throughout a very large volume of the gas, and in the first stage at least, the energy lost in the collisions does not appear in the useful form of heat. It merely results in the electrical separation of the positive and negative parts of the gas atoms, a process known as ionization. Hence, normally the liberated atomic energy is lost for all practical purposes. It is dissipated throughout a comparatively large volume.

Collecting Atomic Energy.

To make use of the kinetic energy of the particles it is therefore necessary to make them lose their speed while traversing a very short path. This can be done by surrounding the parent atoms with a thick-sided box of a very dense metal such as lead. In the latter metal the particles would have so many disabling collisions that they would be brought to rest in a few inches, and therefore the liberated energy would be localized. Ultimately all this energy of motion would degenerate into heat in the same locality, so that if the amount of energy *liberated* was high enough, the lead box would become hot enough to be of value as an ordinary source of power. In the writer's opinion this is the most obvious way of collecting the atomic energy in a useful form.

To sum up, let us imagine the apparatus which may be used in the future to generate energy from atoms. First we shall have the source of the radiation which by its trigger action will liberate the stored internal atomic power. This will be some form of discharge tube of the same nature as a modern X-ray bulb. The rays from this apparatus will be concentrated in a beam and will pass through an aperture into a lead box. At the centre of this box there will be placed in the path of the rays the piece of matter which is to provide the energy. The lead box itself will be the storehouse which by its rise of temperature will boil water to produce steam, or in some other way transform the power to useful work. If the apparatus is able to utilize even a small fraction of the total mass of the piece of matter, then this arrangement will be the most powerful source of energy that the world has ever seen.

Is the Panda Dying Out?

THE arrival at the Zoological Gardens of three specimens of that rare and interesting animal the panda, or "cat-bear," forms an addition of considerable interest. The colouration of this animal is striking. The fur is of a rich chestnut-red, with white markings on the head, and black rings round the conspicuously long tail, while the under parts are almost black instead of the normal white. Though strictly speaking a carnivore, it is almost omnivorous.

The present geographical distribution of the pandas is restricted to the Himalaya from Nepal to Yunnan, at an elevation of 6,000—11,000 feet, where they haunt trees or hide among boulders as circumstances determine, emerging in the early morning and evening to forage for food. Not much is known of their habits, as may be imagined from their almost inaccessible haunts, but observations on captive specimens have revealed some interesting facts, especially about their mode of sleeping. Thus at times they will curl up like a cat, turning the long tail over the head; and at times they are said to sleep standing, with the head turned downwards between the forelegs after the manner of their near relations the racoons. When excited they emit a strong odour of musk. As a correspondent to *Nature* points out, the panda is evidently a species which is dying out, for its range in past times was vastly greater. This much is shown by the fact that a panda one and a half times larger than the existing species has been found in the English Pliocene. No fossil remains of pandas have yet been found in America. But having regard to their very near kinship with the racoons, they may yet be found.

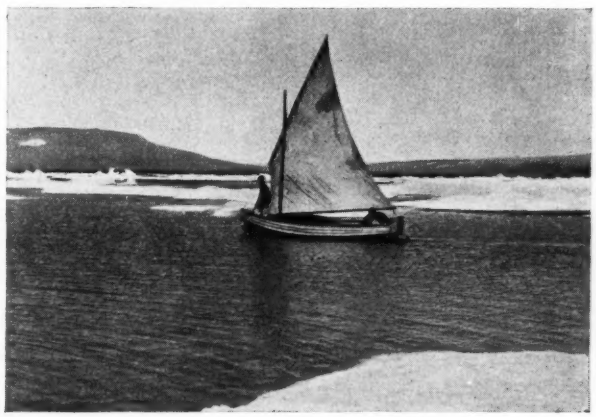
New Light on the Fauna of the Arctic.

By G. C. L. Bertram.

Cambridge Expedition to East Greenland.

Many problems connected with the fauna of the Arctic were solved by the Cambridge Zoological Expedition to East Greenland. Perhaps the most interesting part of the work was the study of insects. The entomologists made use of an ingenious device by means of which they captured minute animals that would otherwise escape observation.

THREE members of Cambridge University, G. C. L. Bertram (St. John's), D. Lack (Magdalene), and B. B. Roberts (Emmanuel), spent a month in East Greenland last summer. The object of the expedition was to make an ecological survey, a type of work in which all of us had had previous arctic experience. Although supported by the Royal Geographical Society and other bodies, there was a very serious problem to be surmounted in the difficulty of getting transport out to Greenland without incurring a prohibitive expense. By great good fortune, however, Dr. J. B. Charcot, the French explorer, very kindly promised that we could join his expedition in the research ship *Pourquoi Pas?* This was going to Scoresby Sound to assist in the evacuation of the Station Paul Doumer, in Rosenvinge Bay (the French contribution to the International Polar Year scheme of 1932-33), and to carry out other scientific work. Without this friendly offer we could never have left England, and until we again reached home we received from the French nothing but the greatest kindness.



The "Phalarope," the expedition's sailing-boat, in Hurry Inlet.

We arranged to meet Dr. Charcot in the middle of July at Akureyri on the north coast of Iceland; and travelled to Iceland by the ordinary passenger route from Hull to Reykjavik. When in Iceland, the opportunity was taken of seeing as much as possible of this very interesting country, and therefore the journey to Akureyri was done by car by a rather roundabout route. The roads that have been opened up in recent years are passable to a good car but they must not be compared with roads in England, as in such a sparsely populated country they are in no way similar. Visits were made to many places of particular interest: Reykir, one of the many groups of hot springs, which includes Grylla, the largest geyser working in Iceland at the present day; Thingvellir, the ancient meeting place of the Althing, brought into prominence in 1929 when the thousand year celebrations were held there; Myvatn, the lake breeding ground of countless thousands of ducks of more than a dozen species, and where more than 50,000 ducks' eggs are annually collected for the market; three great waterfalls, Godafoss, Gullfoss and Dettifoss, the last being one of the largest in Europe and involving a journey of forty-five miles on pony. The source of the Jokulsá, the river of Dettifoss, was discovered by Roberts when leading the Cambridge Expedition to Vatnajökull in 1932.

We met Dr. Charcot at Akureyri on July 18th, but on hearing from him that, owing to reported bad ice conditions in Scoresby Sound, he would not be sailing for a week, we decided to pay a short visit to the isolated little island of Grímsey, lying thirty-five miles northward from the coast. The main interest and object of going to Grímsey was ornithological, and we made a complete survey of the bird life of the island. It is nearly thirty years since an ornithologist visited it. It has been supposed that birds breed there which are otherwise unknown to do so in Iceland, and to a very limited extent this is true; but most of the former beliefs have been based on the fact that no one has definitely proved the contrary.

The Knot has been stated to breed there, but so far as present evidence goes this is not so. Grímsey has the most southerly breeding colony of the Little auk, but this has now been reduced to five pairs at the most, a reduction from its certainly much larger size in the past that can be directly attributed to the collection

of eggs for sale to collectors. In addition the island possesses the most northerly gannet colony in the world, consisting of about twenty pairs of birds, and the well-grown fledgelings are taken for food as in other parts of Iceland. Two of the islanders let us down 270 feet of cliff on ropes so that we could examine the colony at really close quarters.

Returning from Grímsey we left Akureyri on July 25th in *Pourquoi Pas?* The 27th and the 28th were spent in the passage through the pack-ice which was accomplished without serious difficulty, though the ship was hove to for short spells and for the night, owing to fog making it impossible to see the leads. On the afternoon of the 28th we sighted Cape Brewster, the southern headland at the mouth of Scoresby Sound. In the extremely clear atmosphere the entrance to the Sound appeared only a few miles wide, and it was difficult to realize that actually it was as wide as the English Channel at Dover, a distance rarely seen across. *Pourquoi Pas?* reached Rosenvinge Bay early the next morning and, after a shot from the cannon by the Governor of the Eskimo colony, the French were welcomed by their friends from the station who had been left there in the previous August. All were well and much useful meteorological work had been carried out in accordance with the International Polar Year scheme.

Polar bears swimming near Cape Dalton.

We stayed in Rosenvinge Bay for a few days and then *Pourquoi Pas?* proceeded up the Sound to enable her scientists to carry out their work on Milne Land at its head. We were therefore left on the morning of August 2nd at Point Constable, a delta on the west side of Hurry Inlet, a subsidiary fjord running northwards from Scoresby Sound. Here we established our camp and began our work in the country round about, a much dissected plateau leaving bare-topped hills with well vegetated intervening valleys. The valley bottoms are often carpeted with a heath of arctic bell heather with an intermixture of dwarf willow and sometimes birch.

This rich vegetation rapidly gives place to scattered plants and finally to bare rock and earth as the valley sides are followed upwards. These heaths are the feeding grounds of the musk ox, and herds of eight or ten were often met with wandering slowly over the country, while solitary bulls were always in evidence. Judging from this particular area, which is admittedly far better vegetated than most localities in East Greenland, the musk ox is much more abundant than has often been supposed, but the Danish Government has wisely made regulations, which are naturally difficult to enforce, against the purposeless slaughter of the animals. One habit of the musk ox it is well to remember; when alarmed it invariably charges uphill, and another point is that solitary bulls are better avoided. This latter, however, in a country with much dead ground, is not always possible, and the results are sometimes startling.

A topographical survey of the area in which the expedition was working was made, including the river systems at the head of Hurry Inlet and to the west and north of Point Constable. Mapping was also carried out on the Liverpool Land ice cap and the positions of a number of glaciers and nunataks were ascertained.

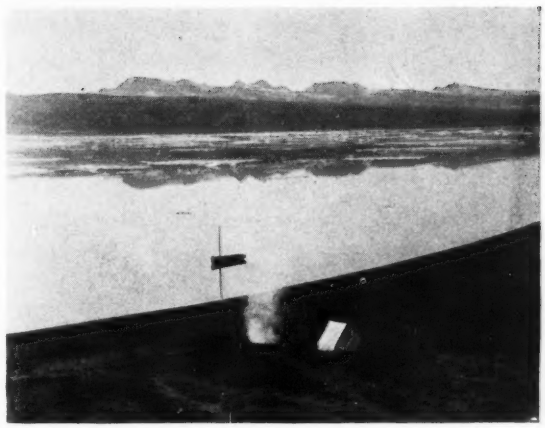
The zoological work covered all the land and freshwater groups, but was concentrated on the arthropoids, which in the arctic are even more noticeably the dominant group of animals than in temperate lands. A collection was made of only a few birds since the nesting season was almost over and many species were already going into winter plumage. Also a certain amount of ornithology had already been carried out in the district. Perhaps the most interesting discoveries were the breeding of Lapland bunting and Red-necked phalarope further north in East Greenland than previously known. 1933 was an extremely bad year for lemmings and no long-tailed skuas or snowy owls, which depend largely on the lemming for their food, appeared to be breeding. A number of water birds also appeared to be nesting in extremely reduced numbers. These periodic "bad" years, whose cause is still far from certain, must have a marked influence on the numbers of the bird population in Arctic countries.

The freshwater fauna was investigated in various

types of country, including the low lying ponds at Point Constable and in Liverpool Land, some well-vegetated ponds at 1,000 feet on Jameson Land, and the more barren lakes at the bottom of the glaciers in Liverpool Land. The arctic char was present in some of the rivers coming directly from the glaciers, and was sometimes living in water so heavily laden with silt that aquatic visibility from above was limited to little more than an inch.

The main collections of insects and spiders were made round the base in Hurry Inlet, but small collections were also made at points on the homeward journey in *Pourquoi Pas?* Ordinary entomological collecting methods were used, and in addition a most useful device invented by Berlese. In this apparatus, which was of specially simple construction suitable for work in the field, moss and other vegetation likely to harbour a large arthropoid fauna, is placed on a gauze over the mouth of a funnel heated by a water jacket. The reaction of collembola, mites and other small forms under these conditions is to burrow downwards, which they do, and fall through the gauze into the slippery sided funnel and are collected in alcohol below. By this method a large number of minute animals can be captured that would otherwise escape observation. A further advantage is that the funnel may be filled with boiling water and then left to itself, while the collector can go off and work elsewhere. The funnel was of particular advantage in "running through" the moss and other plants brought back from a nunatak.

Experimental observations were made on the reactions of insects to low temperatures. An apparatus had been constructed in which the insects were placed and their temperatures lowered by means of a freezing mixture of salt and snow to any desired figure. The lowest temperatures at which each species of insect could remain active was noted. The species varied very considerably one from another; for example the arctic bumble bee was rendered inactive at 10° C., as were some Ichneumons, a beetle and a species of moth. On the other hand certain small flies and spiders were able to remain active several degrees below freezing point; and all intermediates between these extremes were to be found.



One of the expedition's camps in Hurry Inlet.

These experiments were performed in an attempt to correlate the geographical distribution of arctic forms with a definite factor in the environment. Thus it is quite clear that the bumble bee could not inhabit an area where the summer temperature never reaches 10° C., whereas many forms which can remain active below that temperature may be capable of making use of the region. These experiments suggest a possible explanation of the marked variations in the numbers of individuals of a species that may occur from year to year in arctic countries. The summer temperature varies greatly, and if in one year, for instance, only five days reached a temperature great enough for a particular form to become active, a lesser number of eggs would be laid than would be the case in a year where perhaps twenty days exceeded that "critical" temperature. Such variation would greatly affect the number of individuals appearing in the next year.

Work was carried on in the Constable Point area until August 8th, and then, taking equipment and provisions for a few days, we left in *Phalarope*, our sixteen-foot lugsail boat. The night was spent in a little harbour at the northernmost of the Fame Islands, where collections were also made. Here as elsewhere we were able to make a great fire of drift wood, of which there is much all along the East Greenland coast.

An iceberg on the Blosseville Coast.

The wood is almost entirely coniferous and comes from northern Siberia, whence it is carried westwards by ocean currents, being finally thrown ashore after perhaps two or more years in the water.

An Unknown Glacier.

The next day we crossed to Liverpool Land, the mountainous eastern side of the inlet. The particular object of the visit was to investigate the fauna, if any, of a nunatak, the name applied to any projecting mass of rock above the general level of an ice cap. The ascent to the main Liverpool Land ice cap was made by way of a small glacier, and after about five miles across the ice we reached the nunatak desired. This turned out to be close to the eastern edge of the ice cap which was in actual fact much smaller than had previously been supposed. The summit at 3,000 feet gave a magnificent view of the Liverpool Coast with the pack-ice and bergs in the sea beyond. From the foot of the peak ran a big glacier, previously unknown, bearing a very perfect central moraine.

Northwards were the confused deltas at the head of Hurry Inlet and an ice field with many scattered nunataks and bare peaks, while to the south lay the entrance to Scoresby Sound and the land behind Cape Brewster. Westwards stretched Jameson Land, and beyond that a blue strip dotted with bergs, North-west Fjord, a branch from the main sound, and further still range upon range of sharp pointed mountains running back to the faint glistening white of the central Greenland ice cap, over 100 miles away. This was the view as we stood there at midnight with the sun just hidden below the northern horizon.

The nunatak was examined for animal life, and a parcel of moss and other plants taken back to be put through the Berlese funnel. The results showed that Collembola, Chironomid larvæ, and small spiders can inhabit such a locality, where the conditions of life are the most rigorous that can be found; and from this knowledge naturally follows the possibility that such small forms of life could survive through a glaciation when nunataks were in all probability always present. After making further collections we returned to Constable Point two days later, navigating with the lugsail through the pack that had drifted into the inlet with a southerly wind. From August 13th to 15th we again visited Liverpool Land, this time further to the south in order to collect in lakes lying at the foot of glaciers there descending from the ice cap.

On August 7th there was a storm and the first snowfall of the coming winter covered the hill tops. One result of the storm was that a sand spit was built out across a bay in the delta edge where *Phalarope* lay moored, so preventing her again reaching the sea; and there she had to be abandoned. Next morning *Pourquoi Pas?* took us off. After a stay of one night at Rosenvinge Bay the ship sailed southwards along the coastline named after the French naval lieutenant Blosseville, who sighted it and perished in an attempt to reach it, just one hundred years before. The Blosseville coast extends for nearly 300 miles and is almost always guarded by heavy pack. The whole length of it was traversed in 1900 by the Dane Amdrup with five companions in a magnificent open boat journey with oars and sail. In 1932 this coast was for the first time continuously followed by a ship under the command of Capt. Ejnar Mikkelsen, a fellow countryman and a member of Amdrup's party. In 1933 ice conditions were again abnormally good late in the season and *Pourquoi Pas?* was able to follow the coast in the same way down as far as Cape Grivel, an appropriate centenary of the sighting by the Frenchman Blosseville.

During this southward journey no pack was met with, but only a large number of bergs of glistening blue ice. A short halt was made at D'Aunay Bay, and then Dr. Charcot took his ship in close to the great glacier of Stor Brae. This is almost four miles in width across its crevassed and broken surface, and terminates in a serrated vertical ice cliff in the sea from which bergs are carved under the influence of a heavy swell. The coast is mountainous and made up of basaltic flows weathered into ragged terraces. At intervals glaciers run down towards the sea through valleys that they have carved, but often at the present day the glacier no longer actually reaches the seaward end of its valley.

A Forsaken Coast.

Another halt was made at Cape Dalton, where the geologists were particularly interested in what is reputed to be an eocene bed, the only one in the whole of East Greenland. Here there is a hut in which Amdrup and his party wintered on their boat journey. It is still in good condition and was re-provisioned by Mikkelsen in 1932 for the benefit of any Eskimos should they attempt the long and difficult journey from the southern colonies to the new one in Scoresby Sound. The undisturbed nature of this coast can be judged from the fact that at the same time from one point at Cape Dalton we could see five polar bears, two separate adults and a female with two well-grown cubs. The latter were at play in a bog and later after a scramble on the cliffs entered the sea.

The coast of Greenland was left at Cape Grivel, and *Pourquoi Pas?* under full sail made for Reykjavik.

A "Divine King" Who is Sacrificed.

By C. G. Seligman, M.D., F.R.S.

Professor of Ethnology, University of London.

*Professor Seligman is the leading authority on the peoples of the Southern Sudan, of which the Shilluk is one of the best known tribes. He here describes how the "divine king" of this tribe is ceremoniously put to death before he reaches senility, for if the divine spirit were not housed in a healthy body the fruitfulness of the land would cease.**

THE Southern Sudan may be regarded as beginning about 200 miles south of Khartoum, and may be divided into two areas, the northern part inhabited by Nilotic tribes, and a smaller southern area inhabited by a number of less known tribes. The Nilotes are scattered along the course of the Nile and out into the basin of the great river Bahr-el-Ghazal, occupying almost the whole of this vast low-lying area. They are characterized by great height and a very dark skin, and they are long-headed. These physical characteristics differentiate them clearly from the people who live on the drier land round the edges of the Nilotic swamps.

The "Rain Maker."

The two best known of the Nilotic tribes are the Shilluk and Dinka. The king of the Shilluk is supreme head of State and Church, if I may put it that way. Not only has he the full judiciary functions which we associate with the unconstitutional monarch, but he is also high priest of his people, and he and his ancestors before him are all considered to incarnate the spirit of Nyakang, the first ruler of the Shilluk, and the founder of the nation. It is because this semi-divine spirit is incarnate in every Shilluk king that he can make rain. This is his most important function, and it is on account of this power that he rules. In fact, the Shilluk king belongs to that class of ruler to which Sir James Frazer has applied the term "Divine King." Such kings are killed ceremonially when they show signs of old age or chronic ill-health, and until the Government intervened the Shilluk king was done away with by his people when he began to get old. For if the divine spirit within him were not housed in a healthy body, the fruitfulness of the land would cease, the crops would not grow, and men and cattle would dwindle away and become weak.

The fact that their kings are killed is perfectly well known to the Shilluk. It is, however, a different matter to discover exactly how they are killed. First of all, the ordinary Shilluk probably does not know and does not care to discuss the way in which his almost divine ruler is put out of the way. But it really is remarkable how closely the killing of the Shilluk king agrees with the theoretical pattern worked out by Sir James Frazer. Although at the present day the Shilluk king is killed more or less ceremonially after the matter has been discussed by the elders of the Shilluk nation, their legends, which in my opinion are good folk-lore, point back to the time when any one of the ruling house who could kill the king would himself become the ruler. The present king is perfectly safe from any such attack, though when my wife and I first visited the Shilluk in 1909 the king never slept at night, but took his rest by day, for the old fear that he might be attacked as he slept was still upon him.

The first stage then was that any one of the ruling family who could get at the king might kill him. Then came the period when the king was killed ceremonially by being walled into a clay hut and left there to die, the hut being watched so that he could not break his way out. This was such a painful method that not more than about 100 years ago one of the kings decreed that no other king should die as he was dying, and some form of strangulation was substituted. Nobody has been able to discover exactly how that was carried out, but we know it was done by a certain group of people called the Ororo, a mysterious class who trace their origin to the third Shilluk king.

An Interesting Custom.

There is now a royal village, Fashoda, from which the Shilluk kings have ruled their country for a number of generations, but there was a period, not so very long ago, when the king ruled from the village in which he was born. Whenever a royal wife became pregnant she was sent away to a village and her child was brought up there. In the old days there was always some doubt as to who should succeed to the throne, but whoever was chosen ruled the country from his own village. This is particularly interesting, because it seems to be an instance of evolution in custom without interference by any outside civilization. The cult of the divine king has become so predominant that the Shilluk have comparatively little of the cult of their own ancestors. Ancestor-worship, which is the chief feature in so many African religions, has become insignificant.

*Extracts from a lecture to the Royal Society of Arts.

Science and Religion—VII.

What Is the Future of the Universe?

By the Very Rev. W. R. Inge, K.C.V.O., D.D., D.Litt., F.B.A.
Dean of St. Paul's.

Jeans and Eddington "share a prejudice against the endless duration of the universe": how can this be reconciled with the Christian hope of eternal life? This is among the religious and philosophical implications of scientific discovery here discussed by Dean Inge, with special reference to space and time.

THE subject which has been chosen for me is sufficiently comprehensive. Several years ago I wrote the last of a series of essays in a book called *Science, Religion, and Reality*, in which, as requested, I tried to sum up the contributions of the other writers, with reflections of my own. I have also given a short statement of my opinions in the first volume of that interesting book, *Contemporary British Philosophy*. Lastly, I have tried, in a book published in the autumn of 1933, to consider the religious and philosophical implications of recent scientific theories and discoveries, and particularly of the conviction held by our leading astronomers and mathematicians that the Second Law of Thermodynamics is unassailable, so that the ultimate extinction of the universe as we know it is certain.

Important Questions.

I showed that the acceptance of this verdict raises important questions for the philosopher and theologian. The philosopher cannot avoid considering with increased interest the very difficult problem of the status of time in reality. The theologian, who has already abandoned the notion of a geographical heaven above our heads, must reconsider the popular identification of eternity with unending duration. These are not new questions; but in a democratic age a problem becomes practical when it is brought before the eyes of the man in the street.

The reviews of *God and the Astronomers* (I apologize heartily for that dreadful title and for the star-spangled jacket) have not helped me very much—reviews seldom do. One of my critics, Lord Rutherford, has evidently not read the book, since he supposes it to be an attack upon the Second Law. That eminent man is no doubt much better employed than in reading my books, but in that case I think he might be better employed than in reviewing them. I expected to be torn limb from limb by Professor Alexander, if he deigned to notice the book at all. But that kindest and most courteous of men has dealt very gently with me, in the *Manchester Guardian*. Of course, he objects to my philosophy of values on the ground that a value must satisfy somebody, and that I will not allow this criterion to be applied. This, however, only makes clear the main crux of the whole problem—the question of time. If God is only encountered towards the end of a temporal process, and if we can hardly say that He exists till He is so encountered, there is no conscious subject for whom the supreme values are truly real, and so they are not truly real. But the Great Tradition in philosophy—at any rate in Platonic and Christian philosophy—finds the actualization of the supreme values in the mind of an unchanging and eternal God. Immense difficulties remain; but this particular objection does not trouble me.

I do not think the old antinomy—and the old impasse, "Are time and space infinite or bounded?"—have been transcended or solved by the Modernist science and philosophy. I know I am out of my depth when I try to understand Einstein's statement (accepted by Jeans, Eddington, and others) that space is "finite but unbounded." The only explanation, adapted to the meanest intelligence, my own, that I have seen is that if you walk round the edge of a circle you will come back to the place from which you started. This is from Sullivan's excellent but misleadingly named book, *The Limitations of Science*. Well, we all knew that without Riemannian geometry. We have even known circular arguments. But perhaps I don't want to walk round the circle; perhaps I prefer to dig through it. Then I shall not come to the place from which I started. Or perhaps I want to leave the circle altogether. A disrespectful but by no means negligible American critic says: "If Einstein thinks that nobody can jump off his circle, he can't know much about fleas."

Can Space Expand?

We are told also that space is expanding. As far as I can understand, by "space" they mean space occupied by matter. The nebulæ are receding from each other and from what we may call their centre. Is it really a foolish question to ask, Into what are they expanding? Does not the whole theory rest on the familiar Euclidean and Newtonian

concep on of space? And does not the idea of space imply that there is no point anywhere with nothing beyond it?

Similarly with time. Eddington very candidly says that his theory demands that time "started off with a bang," and that he cannot believe this. If it did not start off with a bang, at a date which we could name if we knew it, why did Entropy not run its course much sooner, or, if it had no beginning, how can its entire content consist of a process with a beginning, middle, and end? I would go further and ask, Is it not part of the conception of time that there is no moment within it which is not preceded by one moment and followed by another? Does the mathematical synthesis of space-time do anything to answer these questions? I venture to think not. If I am right in thinking that mathematics gives us no help in solving a contradiction which inheres in our very ideas of space and time, it follows that the solution must be sought outside space and time. In other words, space and time proclaim themselves that they are not ultimates, either separately or in conjunction.

Dean Inge.

There is another point which, though it is no business of mine since it is a purely scientific difficulty, I cannot refrain from mentioning. The theory of an expanding universe seems to be quite inconsistent with the time-scale which numerous converging arguments have almost established for the solar system. Most of us know that the age of the sun has been estimated at about seven or eight billion years, and that of the planetary system at about two thousand million. But the greatest age compatible with the theory of an expanding universe is one of some thousands of millions of years. If the galaxies are receding, it has been calculated by tracing the process backwards that all the universe would have been a compact mass long before we get back to billions of years.

To the outsider, this looks like the famous old quarrel about the age of the earth, between physicists and geologists, and about the age of the sun before radio-activity and the annihilation of matter were thought of. In this case the advocates of the longer period won. It may be a matter of temperament, but I expect the long period will win again. If, however, the shorter period wins, it is the opinion of some scientists, such as Sullivan, that the theory of a building-up process, from smaller atoms into larger, may become acceptable. In either case, since the degradation of energy and the recession of the nebulæ seem to be well established, and since they are incompatible with each other, there seems to be no escape from believing that some very important principle is yet undiscovered.

I have read carefully Sir James Jean's new edition of *The Universe Around Us*. He does not use the very perplexing theories about space-time, and he does not discuss the scientific difficulty which I have just mentioned. He accepts the usual estimates of the past life of the sun and of the planets. He thinks that the sun may continue to shine for some fifteen billion years, and that the dwellers on earth may drag out a rather chilly existence for a billion years or so. It is, however, possible, as he reminds us, that the sun may suddenly blaze out into a *nova*, or shrink into a white dwarf. Either of these would extinguish our precious race at once.

He will stand no nonsense about the Second Law. "Imagination sees new heavens and a new earth coming into being out of the ashes of the old. Science can give no support to such fancies. She cannot prove that the fanciful will not happen—she can only calculate the odds against it happening. And these prove to be so enormous that we may safely disregard altogether the possibility of its occurrence." He adds: "Perhaps it is as well. It is hard to see what advantage could accrue from an eternal reiteration of the same theme, or even from endless variations of it." This seems to me an odd point of view—a kind of prejudice against endless duration. Eddington shares it.

For most of us the prospect that the whole of history will one day be as if it had never been—that nowhere in the vast universe will there be life or intelligence or consciousness—is rather chilling. We may have to accept it; Jeans and Eddington say we must; but I do not find it easy to say, "So much the better." Whitehead, without expressing any preference, leaves a large loophole for future discoveries. "The moral

to be drawn from the general survey of the physical universe, with its operations viewed in terms of purely physical law and neglected in so far as they are inexpressible in such terms, is that we have omitted some general counter-agency. This counter-agency, in its operation throughout the physical universe, is too vast and diffusive for our direct observation. We may acquire such power as the result of some advance. But at present, as we survey the physical cosmos, there is no direct intuition of the counter-agency to which it owes its possibility of existence as a wasting, finite organism." He implies that there must be such an agency, though I do not think he has joined those who find a *deus ex machina* in the cosmic rays.

I may be asked: "Why, since you end your discussion of the doom of the universe by reminding your readers that the Christian tradition has always predicted such an end, and has expected it to come very much sooner than our men of science think probably, should you have gone out of your way to study subjects which are not in your line, and to prefix to a defence of the traditional philosophy of religion a discussion the issue of which, as you say yourself, is not of vital importance to religion?"

I have asked myself this question. I admit that the withers of the orthodox theologian are unwrung. But the orthodox theologian believes in an endless *future*; and when once you use the word *future* you have to find a stage for whatever the future may bring forth. Science can hardly find such a stage, either on this planet or anywhere else. I have in my book answered this by accepting Bosanquet's dictum that to throw our ideals into the future is the death of all sane idealism, only adding that if we attempt to picture our ideals without using the categories of space and time they will have a very ghostly existence for us.

A Doomed Universe?

But my trouble is rather metaphysical than religious. Let us grant that "our earth is but the shadow of heaven"; that "every truth is a shadow except the last"; "that life like a dome of many-coloured glass stains the white radiance of eternity." Here we are on the lines of the Platonic tradition. "Let us fly hence to our dear country." But the visible world is no deceiving phantom; it is the creation and the copy of a higher sphere of existence. "Time," say the Platonists, "is the moving image of eternity." But is a wasting, doomed universe the moving image of eternity, and not rather a moving image of something very different? How can a dying world be a symbol of a world which knows no change or beginning or end? Does not the Second Law, with all that it implies, cut the cable between the Intelligible or Spiritual World and the World of Sense?

That this misgiving is not baseless is shown by the remark of Thomas Whittaker, one of the ablest expositors of the Neoplatonic philosophy. He thinks that the establishment of Entropy as the supreme and final law of the universe would "disprove" the philosophy of Plotinus.

Science and Idealism.

Well, we none of us like to hear that our philosophy has been disproved, and we are not very ready to believe that any discovery in physical science could disprove a time-honoured type of idealism. I think Whittaker puts it rather too strongly. It is true that if the whole of creation can be summed up as the progressive realization of one great divine purpose, and if the end of this stupendous scheme, with all the labour and blood and tears, all the faith and hope and love which it has cost, is to be not the achievement of some splendid result, but final stultification and universal death, we should probably be driven, not towards Platonism or Christianity, but to some Asiatic world-renouncing creed like Buddhism. Human effort having been proved to end in nothing, we should have to admit that man walketh in a vain shadow and disquieteth himself in vain. But a cosmic law of unending progress has never been part of Platonism or of Christianity. It is merely the aftermath of the revolutionary fever of the eighteenth century and a substitute for the Christian hope of eternal life, which was then burning very dim. If, on the other hand, it is the lot of all that is born into the world to fulfil in some measure a finite and temporal purpose in the mind of God, and then to take its place in the eternal order, there is nothing fatal in the discovery that the life of stars and planets, like the life of individuals, has its destined term. Some modern philosophies, which give an absolute value to time and history, are, it seems to me, hard hit by the doom which science pronounces on the universe; but Platonism is not. The way in which this prediction hurts us is rather different. Plotinus teaches that all grades of being, in their various degrees, flow forth from the primal source of Being, the One or the Good or Perfect; and that this overflow from the divine nature is no arbitrary fiat but a necessary result of the Supreme Being or First Principle being what He is. It is no accident that all things are linked together in an unbreakable chain. God creates because, being God, He must; "it is His nature to"; and as long as He is God He must create beings in His own image, though imperfect copies of His perfection. Thus for the

Platonist the visible world is good, beautiful, and holy, and we can hardly believe that there will ever be a time when no rays of the divine perfection will shine in any part of the universe, for intelligent creatures to behold and enjoy. If life and soul and spirit are the result of a strange and unlikely accident in one corner of the universe, a mere evanescent flicker which will soon disappear and leave no trace behind, a local sympton of the disease of dissolution, it hardly seems as if God can be what we have supposed Him to be. I do not say that it destroys my philosophy, but it does to some extent chill my faith.

My way of escape is to remember that we do, as a matter of fact, frequently ascend in heart and mind above the world of time, space, history, and even personality. This is what I mean by reality as a kingdom of absolute or intrinsic values. They are very much the same as Plato's Ideas, as I understand them. I have tried to explain my philosophy of Values in my recent book. But since Professor Alexander is far from satisfied with it, I will offer some comments on his new book, *Beauty and Other Forms of Value*, which has come out since mine was published. This may perhaps make my own position clearer, though the Professor is not likely to regard them as serious criticism.

Interpreting Nature.

" Nature is beautiful," he says, " only if we see it with the artist's eye. The nature we find beautiful is not beautiful in itself; we select and combine; we construct and interpret." Yes, but who gave us the standard? What makes us recognize that this selection, combination, and interpretation of external nature lifts us out of ourselves, makes us happier, and is an enrichment of our personality? The Professor expresses a great deal that I mean when he says: " The beautiful, as that which satisfies an impulse become contemplative, is *disinterested*. . . . In essence, the beautiful is shareable because it is not *personal and practical*." This is in fact the distinction, immensely important, between absolute or intrinsic and instrumental values. This characteristic of the higher values is emphasized in other parts of the book. " In science the mind depersonalizes itself." " Truth is the satisfaction of disinterested curiosity." " The distinctiveness of morality lies in its disinterestedness." This is very welcome as an answer to the pragmatists. In the higher values the " I," the form of reference in the instrumental values, is forgotten. So it is in our religion. " What is the Cross? " said a witty Bishop, speaking to children. " It is the ' I ' crossed out." But in philosophy we have to consider the meaning of this self-transcendence, and it can only be found in the real status of the human soul or spirit in a super-individual order. The same characteristics, as I have shown, are found in, and determine, all the absolute values.

But I am unable to follow this great authority when he makes time and public opinion the arbiter of value. For instance, of Christ he says: " While goodness is the artistry of the gregarious instinct, there is room for the revolutionary moralist, the man who, putting forward a scheme of goodness new and paradoxical, like Jesus, is in fact forecasting a social scheme, who is in truth a genius of a social life which has yet to be, and which if sound wins its way from derision to acceptance." Alas, that is not at all what Christ expected, nor what has happened. " When the Son of Man cometh, shall he find faith on the earth? " Was it the Galilean who conquered with Constantine? " Right for ever on the scaffold, wrong for ever on the throne." Christianity is something much more heroic than an intelligent forecasting of the way the cat will finally jump. There is, I am afraid, no doubt that Professor Alexander makes public opinion, which he frankly calls the tyranny of the majority, the supreme arbiter. " The only rights," he says, " are claims that have been recognized." So there are no natural rights, no absolute standard of justice and injustice.

Before proceeding further in a defence of my conception of absolute values I should like to say something in reply to an exceedingly kind review of my book by the great mathematician Professor Whittaker of Edjnburgh. He thinks I have paid too much attention to Entropy, which, he says, " is not established beyond dispute. For the argument of Eddington and Jeans is based entirely on the classical or non-relativistic thermodynamics. . . . Tolman has shown that in certain cases a universe expanding or contracting can do so reversibly." Well, more power to Tolman's elbow; I have suspected something of the kind myself; but relativistic thermodynamics is out of my depth. He then says: " The distinction between finiteness and boundedness is obvious to a mathematician, but seems to be very difficult for everybody else." It certainly is; I am afraid our ignorance is " invincible," as the Roman Catholics say in their charity to poor Protestants.

A Mathematical View.

What follows is more important still. I have argued that a scientist has no right to take refuge in Berkeleyan mentalism. Professor Whittaker says: " Our knowledge of the objects treated in physics consists in the study of the relations between pointer-readings.

Atoms, electrons, and so forth are not, strictly speaking, necessary in physics at all; they are introduced merely as picturesque aids to the imagination. The mathematics, on the other hand, is inherently necessary." Now no one disputes the right of the mathematician to make what patterns he pleases out of hypothetical or imaginary entities. But if he is really indifferent to the question whether these entities exist *in rerum natura* or not, I cannot help asking why he takes such infinite trouble to weigh, measure, and count material objects which are not mathematical but are given to him as brute facts. We all know the story of the Frenchman, the Englishman, and the German who were set to write an essay about the camel. The Frenchman visited the Jardin des Plantes, and produced a lively sketch of the appearance and manners of the animal. "Voilà le chameau." The Englishman travelled in Africa, and wrote an ill-composed treatise about the habits of the camel as he had observed them. The German retired to his study, and evolved the idea of a camel out of his inner consciousness. He could do this better—as Hegel and Fichte knew—without any exhausting preliminary research. But our scientists are genuine researchers, and they begin with ponderable matter assumed to be real. In the course of their investigations they find that matter, in its ultimate analysis, is not, in the ordinary sense, material. It is defecated to a transparency. Whereupon they say, "Avaunt, ye materialists; I am an idealist!" They have got rid of the dog, tail and all; but they want to keep the wag. The Cheshire cat is gone, but the grin remains. I really don't think we can disprove materialism by making positive and negative electrical charges devour each other like the Kilkenny cats. Besides, are there not queer things called neutrons, not electrically charged, and possessed of weight? Begin with mathematical symbols, and you can end with mathematical symbols, but if you begin with concrete stars and atoms, you cannot end with pure mental concepts. I suppose there is an answer to this, but at present I am unconvinced.

What is Reality?

To return to my main point in constructive philosophy. The old canon that "reality is *one*, true and good" is still to be maintained; it has degrees, but they are degrees of approximation to a fixed and absolute standard. There is no conspiracy to deceive us. To quote a modern writer, what we recognize as value when our life is fullest and our soul at its greatest stretch, that we may confidently accept as real. There is a natural metaphysic of the mind, which refuses to separate value and reality. It does not seem to me to matter much whether our new guides call themselves realists or idealists; that opposition is not fundamental. But to give us a philosophy without an ontology—this is indeed a vital matter.

Beyond Space and Time.

Are there not many things which we feel to be real, but which do not belong to the world of space and time, and which cannot be communicated in the idiom of space and time? We recognize these as part of our knowledge; they are not prejudices, but the foundation of any intelligible theory of reality. Bergson bids us overcome our "prejudice" in favour of the permanent over the changing, and proceeds to make the changing the ultimately real, doing violence to our deepest convictions. As Pringle Pattison says, we must start with a logically unsupported judgment of value. It is logically unsupported just because it is fundamental. These are the bricks out of which we must construct our fabric.

Traditional philosophy has always made ultimate reality non-spatial and non-temporal. But, you will say, traditional *religion* has done nothing of the kind. Well, I have tried to answer this. When our feelings are deeply stirred, we use concrete imagery, clear outlines, and bright colours. We must do so; we need not be ashamed of it. When I think of heaven, or of Plato's intelligible world, it begins to look very like an improved duplicate of the world that I know. Mathematical science clearly wants to substitute a logical order for the empirical space-time order; and with this we have no quarrel, for it means that the intelligible world is not spatial or temporal.

In conclusion, I believe with Lotze that our judgments of absolute value are "the inspirations of reason," and this is the highest kind of authority. We add nothing to their claim upon our confidence by translating them into any subordinate concepts. We see dimly before us a still higher form of experience in which all contradictions are harmonized. This, if we could attain it, would be the goal of religion, philosophy, and science, all three. The beatific vision can be seen by few and described by none. Nevertheless, it is a fact. As Whitehead says, "The fact of religious vision is our one ground for optimism."

THIS article is based on an address to the British Institute of Philosophy, by whose courtesy it is here published. The series will be continued by Professor Julian Huxley in June and July. Previous contributors have been the Bishop of Durham, Mr. Belloc, Professor Haldane, Mr. Marvine and Sir Alfred Ewing.

Correspondence.

SUMMER THUNDERSTORMS.

To the Editor of DISCOVERY.

SIR,—The annual record of Thunderstorms occurring in the six summer months is being continued. Some of your readers have very kindly given me most valuable assistance in the observational work in the past, and I venture to hope that many may be good enough to join in the census between April 1st and September 30th of this year.

A note of the place, date and time of the occurrence of thunder, lightning or hail, in any part of the British Isles, with the direction in which the lightning was seen, especially at night, will be extremely useful. In the case of actual thunderstorms additional information of the following character will be valuable :—

1. Time of first observation of thunder or lightning, with direction and estimated distance.
2. Time of commencement of very heavy rain or hail, or approximate time of nearest approach of storm, with direction and estimated distance.
3. Approximate time of final observation of thunder or lightning, with direction.
4. Severity of storm; changes in direction or strength of wind, changes in temperature, etc., during the storm.

It is essential that the position from which the observation is made should be specified by mentioning the approximate distance and direction from a railway station, and that the standard of time used should be stated. The shortest note for any of the days is of help. More data are particularly required from rural and moorland districts, and from thinly populated areas generally.

Thunderstorm Census Organization, Huddersfield. S. MORRIS BOWER.

LENDING INSTRUMENTS FOR RESEARCH.

To the Editor of DISCOVERY.

SIR,—When the "Notgemeinschaft der Deutschen Wissenschaft" (Emergency-Society for German Science) was founded, it was as its name implies, intended especially as an emergency effort in the difficult period of economical post-war depression. Its object is the provision of scientific help in cases of valuable research which otherwise would remain unfulfilled for lack of finance. The Society has acquired tremendous significance also as the moving spirit in specialized research work, and is a generous loan-institute for scientific apparatus; it also possesses radio active substances and precious metals which it places at the disposal of research workers.

The outstanding position which the Notgemeinschaft fills between the various scientific research branches shows itself above all in the carrying out of the so-called "community work." Support is also given to scientific book-publishers and to the libraries of universities and high schools to enable them to enlarge collections with expensive scientific works, and to subscribe to the important scientific journals of other countries. The Notgemeinschaft has long grown to be an indispensable factor in German science, thanks to its many-sidedness, and the way in which it brings together the various research branches.

I am unaware if we have in Great Britain any similar association; if not, the work of the "N.D.W." might be worth close study.

Adelphi, London, W.C.2. R. E. ROBINS.

JAPAN ATONES TO THE FISHES.

To the Editor of DISCOVERY.

SIR,—In Japan fish flesh is an important item in the diet of all. The only Japanese who do not eat fish are the Buddhist priests, and their creed forbids them the killing of any living thing for food or other purposes.

Most interesting, therefore, is the old Japanese ceremony of "Reconciliation" with the fishes caught, killed and eaten; the festival was for a hundred years in abeyance, but last year it was revived in all its former glory. After a service in the temple, fifty priests in their finest robes assembled on board a modern steamer, where a mass of atonement was held for the fishes sacrificed to men's appetites. The vessel then proceeded through the harbour, and slowly along past the great fishmarket of

The ceremony of "reconciliation."

Tokio before proceeding to the sea; temple music and chants were brought to the service by radio loud speakers to accompany the unending prayers of the priests.

A photograph taken during this ceremony may interest you.

Tokio. NORMAN ENGLISH.

LITTLE-KNOWN LONDON.

To the Editor of DISCOVERY.

SIR,—There are many turnings "off the beaten track" in London whose interesting historical associations appear to remain unknown to almost everyone. The exploration of these secluded streets and courtyards often reveals some interesting facts which may perhaps rank as modest "discoveries." For instance the quaint courtyard known as Pickering Place, off St. James' Street is quite worthy of a visit, yet many daily pass the passage which leads to the court but rarely think of inspecting it. Note, for instance, two picturesque houses, Nos. 3 and 4, with their carved hooded front doors and the decoration, consisting of acanthus leaves and bunches of grapes. See, too, the delightfully quaint wrought iron bell-pulls, which are pear shaped. In 1740, William and John Pickering, grocers, lived there, and the courtyard was named after them. At No. 5 Rouge and Roulette, French and English Hazard, were played, and the courtyard was one of the most notorious and vicious gaming places in London. What puzzles most visitors is the bust of Lord Palmerston. It is, of course, not identified in any way with the Pickering Place, but it appears that some years ago Mr. Harvey, the well-known print-seller, purchased the statue at a sale and afterwards placed it in the courtyard. Mr. Harvey at that time owned a house in the yard.

London, W.C.2. F. W. HERMESSEN.

Infra-red Photography and Illegible MSS.

By Olaf Bloch.

Infra-red photography plays an important part in the deciphering of illegible manuscripts and in the detection of forgery. As chief chemist to Ilford, Ltd., the author has been prominently associated with research in this branch of photography which has many interesting applications.

PHOTOGRAPHY is of particular value in enabling us to obtain permanent records of documents, and it is therefore not surprising that it has been much employed in the detection of forgery, the deciphering of illegible or faded documents, over-writing and the like. Generally speaking ultra-violet photography is the most useful process to employ because many materials, including paper, fluoresce in ultra-violet light, and any difference in colour or intensity of fluorescence between the base and the material employed for writing or printing on it can therefore be photographed. In some cases, however, the infra-red method is valuable. If there is a difference in reflection or absorption of infra-red light between the base and the ink, or between the two inks on one and the same base, then we can hope to photograph it successfully by this method.

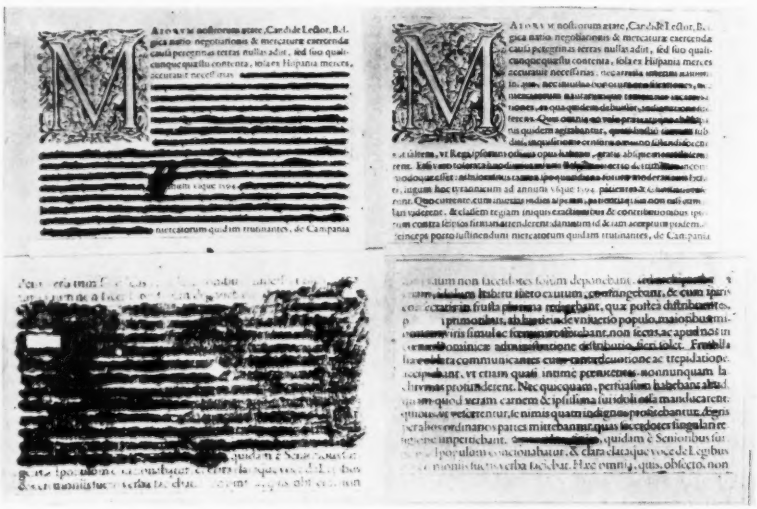


FIG. 1. *Two pages from de Bry's "Voyages," photographed by ordinary methods (left) and by infra-red photography (right), revealing the deletions.*

One of the first examples of such work is shown in Fig. 1. This is a photograph taken by Bendikson in 1932 of pages from a copy of Theodore de Bry's *Voyages*, which is in the Huntington Library; these pages had been obliterated in black ink by the Inquisition Censor three hundred years ago. Here the obliterating ink has been different in composition from the original ink; it is relatively transparent to infra-red light and therefore does not record in the photograph. The interesting picture shown in Figs. 2 and 3 is of a piece of leather in the British Museum and is due to the differences between the reflecting and absorbing powers of the leather and the ink. This piece of leather dates from about 1200 B.C. and was used for writing upon more than once, the older script being cleaned off. It will be noticed that evidences of two sets of inscriptions are clearly visible. In this case nothing of any value could be detected by the eye in the original, but the legibility of the infra-red photograph is all that can be desired.

Indian ink contains carbon black, and carbon is one of the best absorbers of infra-red light. This is useful for photographic purposes because the black paper in which photographic materials are wrapped has carbon black as its pigment and is very suitable for the protection of infra-red sensitive plates or films. Similarly, the shellac-spirit-lampblack varnish so much employed by photographers is equally useful for the same purpose. Now ordinary ink does not readily absorb infra-red light and, therefore, if we write in Indian ink and erase the writing with ordinary ink we shall be able to photograph the first impression, but if we perform the reverse process we shall meet with no success. This can be shown in an altered price ticket, photographed first by ordinary methods and then by infra-red photography. The latter will show the alteration, where the actual pencil writing has been gone over with ink and the price put up, as is alleged to be done occasionally at sale times!

Dyes also behave variously towards infra-red, and it is not difficult to find black woollen, cotton or silk

materials some of which photograph dark and others light. This has led to the belief that it might be possible to dye fabrics with such a black dye that they would be as cool to wear in summer as white materials, but this hope has not yet been justified.

In conclusion it must be said that we do not yet know the particular molecular arrangements to which these differences that we have been discussing are due.

Infra-red photography has, of course, many other uses, and one of its most interesting features is the way in which foliage is rendered white, especially in sunshine, thus causing a summer landscape to appear as if it were a winter snow scene. This is due to the fact that chlorophyll—the colouring matter of leaves—reflects a large amount of the infra-red light which falls upon it and transmits most of the rest, absorbing very little. It is therefore rendered dark in the negative.

The coloured modifications of chlorophyll behave in a similar manner, and it is instructive to photograph buds and shoots at this time of the year by the infra-red process.

If we take, for instance, an ash branch with its black leaf buds as yet unopened and its pinkish blossom heads, a horse chestnut with the fresh green just emerging from the black bud, or the bright red shoot of a peony, and make infra-red photographs of these, we shall find that the reds, greens and pinks are all rendered dark upon the negative, while the dark buds and stems, as might be expected, yield no picture at all. For some reason, therefore, infra-red light is not required by chlorophyll and its congeners, and there can be no doubt that if we attempted to grow a plant in infra-red light it would bleach (etiolate) and wither in precisely the same way as occurs when we attempt to do the same thing in red light. Flowers and fruit generally behave in the same way, but we do not yet know if this rejection of infra-red is due to the somewhat greater heating effects which would be produced if light at this end of the spectrum were absorbed.

[*Ilford*

FIG. 2. *An inscription on leather, dating from about* 1200 B.C., *which is quite illegible.*

[*Ilford*

FIG. 3. *The same inscription revealed by infra-red photography and thus made quite legible.*

Much scientific work depends upon differentiation, and it is this property of materials to absorb and reflect infra-red light differently from ordinary white light that enables us to take and compare photographs made upon the usual photographic material with infra-red ones.

In the case of aerial photography, for instance, some features of the landscape are rendered upon one negative and not upon the other, while other features are rendered differently upon each. Thus a comparative study of the two can provide much useful information.

Exploring a Coral Reef.

By Robert Gibbings.

In forty thousand miles of travel the author has seen nothing to surpass the beauties of the tropical fish in a coral reef off Tahiti. This account of his observations during several weeks is accompanied by an original wood engraving.

Most visitors to modern aquaria, such as that at the London Zoological Gardens, are under the impression that they have seen tropical fish in all their beauty; and so was I before my visit to the South Seas. Even in a tropic vivarium such as that at Bermuda the inhabitants of the ponds are but mere shadows of their former selves, the markings on their bodies scarcely perceptible and the colours almost completely faded. Before I went to the South Seas I visited the London Zoo in order to gain some idea of what I was likely to see on my travels. What I saw was full of promise, but when, on my return from abroad, I visited the same collection it was hard to believe that I looked at the identical species I had seen amidst the coral.

Wherever man has gone he has soiled the face of nature and even about the villages of coral islands the lagoons show too ample evidence of the cannery. There are, however, still hundreds of thousands of acres of coral garden unspoiled and unspoilable, and in sheer beauty these surpass anything the writer has seen in forty thousand miles of travel.

First obtain your waterglass, just a box about twelve inches cubic measurement, with a glass bottom and no top. Rest the glass on the water and it will prevent refraction. Looking into the box you will see everything in the water as clear as in ordinary daylight. Now imagine water as clear as air. Imagine yourself floating in a canoe, carried slowly along by currents of air or water, while you lie full length and gaze through a glass at this never ending kaleidoscope of living colour. The water in the lagoon varies in depth from a few inches to several fathoms; a few yards from the shore you may be in either depth. From the sandy floor of the lagoon rises coral in every possible formation, in shallow water your canoe grates on the white stag antler growth; a moment later you look into the heart of a huge hollow rose-coloured sponge or your keel passes between the purple fingers of some mighty calcareous hand.

Catching the Fish.

In every crevice will be found a fish; in a globular lump of emerald coral, not three feet in diameter, may be seen many hundred bright blue atoms, darting in unison now here now there or, resting immobile, they attempt to conceal their existence until the curious apparition of a tree trunk with human eyes has passed. These tiny creatures are difficult to catch; their mouths are so small that it is impossible for them to take anything which could hold a hook, so that only a net can be used. But no drag net can be used among the myriad spikes of coral which form their home. It is necessary to lay a trap of very fine mesh which with one quick stroke can be closed and then carefully brought to the surface. Friendly and leisurely as these small sprites are, they are quick as an arrow when alarmed.

A Hundred Species.

But why catch them? Their glorious colours will fade as you watch them. There is an island called Tetiaroa, twenty-five miles north of Tahiti, and even in the South Seas it is famed for its fish. In that lagoon I have spent some of the most glorious hours of my life. Filling my mouth with cocoanut I would clamber along the reef until I had found a likely pool, then sitting on a ledge of coral immersed to the chin I would chew the cocoanut into pulp and let it fall into the water.

Sitting quite still the white cloud about me would soon be filled with a thousand fish, closer and closer they would dare until with confidence they would come and suck the morsels of nut from any part of my body where it had chanced to rest. In five minutes I would have seen a hundred species, from the little black swallowtails and the tiny zebras to torpedo-headed Oiri with the Astrakhan patches on its stern and cobalt blue stripes across its head. The colours of most of these fish are prismatic and the artist's brightest pigment could scarce do them justice. The markings of many of them are as definite as the designs on camouflaged battle ships, some longitudinal, some horizontal, sometimes the same pattern with different colours, sometimes the same colours with different patterns. Even after four months of almost constant study in the same localities it was impossible to spend an hour in observation without finding a new acquaintance. There was the Vache de mer, called Moa in the Cook islands, with his large cow's eyes and pair of horns. There was the Tahitian Hue Hue, called Sue Sue on Penrhyn island. He is generally known as a coffer fish and he lives enclosed in a cartilagenous coat of mail and is reputed to have no back bone; his

[*By courtesy of the Orient Line*

"The Reef," a wood engraving by Robert Gibbings.

fins and tail have the appearance of working on hinges. On one side of Tetiaroa this fish is considered a great delicacy for human consumption: on the other side of the island he is deadly poison, the difference being probably due to variation of feeding ground.

Black and orange are the favourite colours for embellishment, the enlarged dorsal and anal fins being most frequently chosen to display such vivid contrast; but alternately or in addition, bands of these colours cross the head in sharp opposition to the horizontal markings on the body. But life on the reef is not all romance; there are sharks who are intensely interested in human shapes and markings! There are the stone fishes who lie disguised, waiting for their prey; if the ichthyologist or other human should step on this "stone" a spine will pierce his foot and he will be paralysed or dead within ten minutes.

Wealthy tourists are rowed over the lagoon in glass bottomed boats, and they see with acclamation those few fish who are not frightened away; but the more modest explorer will have his own dugout and his "waterglass." And when he walks on the reef he will wear a stout pair of hob nailed boots and in case of accidents he will carry a spear. This simple equipment will open to him a world whose beauty no words can describe.

The Making of a Great Sea.

By Charles Davison, Sc.D., F.G.S.

To the west of the Japanese Islands and separating them from the continent of Asia lies the Japan Sea. Its width varies from one hundred to five or six hundred miles, or nearly double that of the North Sea. Compared with the Pacific Ocean to the east of Japan, which in the Tuscaroora Deep rapidly descends to a depth of five miles, it is a somewhat shallow sea, for at no point does its floor reach quite two miles below the surface.

The interest of the Japan Sea lies to a great extent in its comparative youth, for it must be numbered among the youngest seas of the earth. That not very long ago it was joined to the continent seems clear from the close relations that its animals and plants bear to those of Asia. Recently, new evidence has been obtained that throws light on this connexion. In the summer before last, one of the ships of the Japanese Navy was employed in sounding in the Japan Sea. On one occasion, the dredge brought up a rounded pebble of granite from a depth of about 1,500 feet. A single pebble such as this might not possess much significance, but, as it happened, others were found not far away by members of the Imperial Fisheries Station. These pebbles, five in number, were picked up at intervals of about twenty miles from the surface of a submarine ridge that runs in a northerly direction from the south-west corner of Japan. Still later, more sand and gravel were brought up from near the spot where the granite pebble was found.

The pebbles range in size from little more than grains of sand to blocks nearly two feet in length. They are either rounded or at any rate have their angles rubbed off, and their surfaces are smooth, almost polished. It would be difficult to distinguish them from many another pebble found on land or in shallow seas near the shore.

The problem is to determine how these pebbles came to lie at the bottom of the sea and so far away, three hundred miles or so, from the coast of Japan. Professor Tsuya, the Japanese geologist, who has studied them closely and has recently described them in an interesting memoir, considers that they cannot be ballast thrown over from passing ships. Their wide distribution, over an area eighty miles in length, makes such an explanation improbable, and moreover they were brought up from the surface of a well-known submarine bank. Nor could pebbles of such size, he justly urges, have been drifted by ocean currents to so great a distance from the shores of Japan, nor rounded in still waters one-third of a mile in depth. There remains the alternative—and this is the view taken by Professor Tsuya—that they have not been transported at all, but that the sea-floor on which they lay was at no very distant date either dry land or shallow coastal water. The sea-bed then sank, either slowly, or, like the bed of Sagami Bay after the earthquake of 1923, by swift stages.

Other evidence that such sinking has recently occurred is by no means lacking. All round the western coast of Japan, as Dr. H. Yabe has pointed out, are two wide shelves that at some previous period must have formed land-surfaces of a greater Japan. The upper or continental shelf has an average depth of about 500 feet along its outer margin. Beyond this the sea-bed slopes rapidly to the lower shelf, which like the other is flat and wide but with its outer margin at the depth of nearly half a mile. A remarkable feature of both shelves is that they are furrowed by deep trenches or drowned valleys that are direct continuations of the present valleys on land. Not only along the coasts of Japan are such valley relics to be found. They occur also in Formosa and along the eastern border of Korea. Dr. Yabe infers—and it is difficult to resist his conclusion—that the whole of Japan once stood more than two thousand feet higher than it does now. It is clear that an elevation so great must have joined the Japanese Islands, not only with Formosa but also with the mainland.

Over the Greenland Ice Cap.

By a Special Correspondent.

The Antarctic still contains a million square miles which remain to be explored. A British expedition plans to cover 800 miles of new ground by sledge and to map 350 miles of unexplored mountains which have been seen from the air but not visited before and are at present marked as " ice-cap " on the maps.

As briefly announced in *Discovery* last month, a small British Expedition left England for Greenland on 7th April. It consists of only three men, as a sledging journey of a thousand miles is necessary in order to reach and traverse the *terra incognita* that is their objective. The leader of the expedition is Lieut. Martin Lindsay, who was a member of the British Arctic Air-Route Expedition of 1930-31, and the other two members are Mr. Andrew Croft and Lieut. A. S. T. Godfrey, R.E. Although the expedition is a private venture, it has been organized under the patronage of the Prince of Wales and has received the cordial goodwill of the Danish Government and unofficial support from the Admiralty, War Office, Air Ministry and Royal Geographical Society in the form of a loan of personnel or instruments.

A full announcement of the scope and intentions of the expedition was made in *The Times* on 11th March and 6th April, and a short recapitulation only is necessary. Starting in June, the party will cross Greenland with dogs and sledges from the neighbourhood of Jakobshavn, where Mr. Croft has been making preparations since September. When they reach the western side of the mountains that border the east coast they will turn south and follow them down from lat. 70° N. as far as Mount Forel, which was the limit of the inland survey of 1931. From Mount Forel they will sledge to a food depôt 176 miles away on the coast, where they will be picked up. If successful the expedition will cover 800 miles of new ground and will map and make a geological examination of 350 miles of mountains that have been seen from the air but not visited before and which are at present marked as ice-cap on the map.

The Scientific Programme.

The scientific programme is limited by two factors : time and equipment. Very detailed work will not be attempted as it is impossible to carry elaborate equipment, and the party will be travelling nearly every day. As, however, no previous explorer has succeeded in reaching this inaccessible region any accurate topographical and geological date will be of great value.

The topographical survey will consist of a theodolite traverse, supported with copious photographs. The micrometer theodolite taken is a 3¼ inch model by Watts. A sextant, hypsometer, and six aneroids of various makes complete the survey equipment. The geological impedimenta consisting of a hammer, clinometer and microscope is less complicated though no less heavy as soon as specimens are collected. Four cameras will be used : an Auca, two special Kodaks and a Leica.

New Knowledge of the Ice Cap.

If accurate heights can be obtained throughout the journey, the expedition will go far to completing our knowledge of the conformity of the ice cap. There are various opinions about it but it is generally agreed that between lat. 60° N. and lat. 70° N. the maximum height is less than to the north or south of these latitudes. A subsidiary dome is assumed to exist on the east between lat. 67° N. and lat. 69° N., and it will be for Lieut. Lindsay's expedition to try to determine whether or not this is the case. For this reason no less than six aneroids, and the best that are procurable, are being taken. If it is possible half-way through the journey to get an intersection on to known heights in Kangerdlugsuak Fjord this will give the surveyors a most valuable check.

From photographs taken by air it is known that the coastal mountain belt between Scoresby Sound and Mount Forel is largely composed of tertiary basalts, with probably some interbedded sediments. The nature of the mountains lying to the west of this coastal massif is as yet unknown. It is hoped that this journey will both establish the limit of the tertiary basalt and sedimentary series to the west, and also its relation with the Greenland Metamorphic Complex.

The journey, if carried out as planned, will have a distinct value altogether apart from the scientific programme. Although aircraft and motor tractors have been used in the polar regions they are in no sense in competition with the dog-sledge, which is still the only means of transport for polar exploration in the full sense of the word. It is too readily forgotten that the Antarctic still contains a million square miles that have never yet been seen by the eye of man, and that it is not even known at present whether this last stronghold of nature is one or two continents : one huge mainland or two sub-continents joined together

by a vast shelf of floating ice stretching across from the Ross Sea to the Weddel Sea. Although reconnaisance from the air is of interest, if our knowledge of the Antarctic is to be in any sense completed this can only come as of old through a series of long journeys made by parties of sledging scientists. Any elaboration of the technique of dog-sledging, such as is part of Mr. Lindsay's programme, must therefore prove to be of the greatest value.

The proposed journey of 1,000 miles without *caches* of food en route—the usual method of laying depôts along the first part of the route during the preceding season being impossible on the Greenland ice-cap owing to the formidable Föhn gales which bury any dumps with snow—is an advance of nearly 400 miles beyond distances so far achieved by unsupported parties. Nor has any expedition attempted to travel for so long at this height; for three-quarters of the journey Mr. Lindsay's party will be sledging between 7,000 and 9,000 feet above sea-level.

The leader's plans for this ambitious journey are based on two suppositions—firstly on the fact that the summer temperatures on the Greenland ice-cap are high, and secondly on the excellence of their equipment. From previous observations it appears that although early on in the journey it may be as cold as *minus* 25° F., for the greater part of the time the days will be very considerably warmer. During the latter part of the journey the party can hope to find the sun thawing the snow in the day-time and freezing it again at night; this is the best possible sledging surface, on which the sledge runners slide like a skate on ice.

There can be little doubt that the equipment is the best that has yet been taken by a sledging party. The late Mr. Watkins made a great advance in the technique of sledging, particularly in respect of the rations. The leader of the present expedition has the experience of nearly 2,000 miles sledging with Mr. Watkins in 1930-31, from which he has made his own deductions and minor improvements, both in method and equipment. It is to be hoped that the venture will be blessed by all good fortune. Readers of the *Discovery* will follow the work of the expedition with great interest.

Book Reviews.

Science To-day. Planned by Sir J. Arthur Thomson. Edited by J. G. Crowther. (Eyre & Spottiswoode. 8*s*. 6*d*.).

The Progress of Science. By J. G. Crowther. (Kegan Paul. 12*s*. 6*d*.).

As an expounder of the mysteries of modern science Mr. Crowther is capable and experienced though not, we believe, himself a scientist. This is probably an advantage, since he is able to take a broad and impartial view of science as a whole, which the specialist finds more difficult to do. The first book under review was planned and arranged by Sir Arthur Thomson, probably the most successful expositor of "popular science" in his day. He did not live to see the completion of the scheme which he designed and discussed with the contributors. In an introduction Mr. Crowther stresses the importance of science in the modern world and suggests that it has more influence on life to-day than in any other historical period, a statement with which most people will agree. Every aspect of life is changing rapidly, and it is the aim of this book to consider, first how scientific knowledge concerning man himself is changing and in what direction, and then to discuss the change in the method, and the philosophy, of science. Then the latest information about man's environment is considered; and the next step is to review the new knowledge gained from the practical applications of scientific research. The nature of the universe which contains man, the earth which bears him and the materials of which he and his environment are made are reviewed in turn. It is only when this has been done that the place of science may be truly assessed.

The names of the contributors are sufficient indication of the book's worth. Professor Max Planck's chapter emphasizes how little is really known with any certainty about quantum physics: "When a great new idea appears in science it is tested in all directions, and if it is proved to be fruitful one tries to make it the foundation of a comprehensive and closed system of ideas; thus it was with the theory of relativity and now it is with the quantum theory. As quantum physics at present culminates in the wave function, one tries to give this a final significance. As the wave function has the significance only of a measure of probability, one tries to make the question of probability the final, deepest problem, and therewith makes the concept of probability the foundation of the whole of physics."

Professor Lancelot Hogben has devoted many years to research on human heredity, and contributes a powerful chapter on the present state of our knowledge in this science. He says that the sociological behaviour of man is probably influenced as much by the acquisition of habits as by hereditary constitution: if social organization is to be improved it will be done through the learning of different habits rather than by breeding a new sort of man. The central nervous system by which a man co-ordinates his behaviour more probably contains the solution of the problems of sociology. Other contributors include Sir Leslie MacKenzie on medicine, Dr. R. R. Marett on anthropology and moral evolution, the Rev. M. C. D'Arcy on science and theology, Professor Herbert Dingle on astronomy and scientific ideas, and other leaders of modern scientific thought.

Mr. Crowther's other book is on a less ambitious scale, and is confined to outstanding research in physics, chemistry and biology. The opening chapter somewhat naturally describes the work at the Cavendish Laboratory, Cambridge—the discovery of neutrons, the artificial disintegration of atoms, radioactivity and quantum mechanics—and from there it is an obvious step to Copenhagen and Professor Niels Bohr. The third chapter deals with physical research at Kharkov, under the title of "Soviet Physics." Then the stars and the universe have a chapter, in which the author considers the theory of

the expanding universe and the Nova theory of Stellar evolution; and the review of physical research is brought right up to date by a consideration of Diplogen, the new heavy hydrogen, which comes into a chapter on American research. Having dealt with outstanding discoveries in physics, Mr. Crowther devotes one long chapter to "The Chemistry of Evolution," in which he deals with such aspects of his subject as the influence of social ideas on scientific research, behaviour and evolution, the evolutionary significance of the egg and the internal structure of living matter; and the book concludes with a chapter on human heredity and one on pernicious anæmia. In less than three hundred pages the author has succeeded in presenting an accurate and instructive review in reasonable detail, and there are several interesting photographs. The book cannot fail to add to Mr. Crowther's reputation as a lucid and entertaining writer on subjects which are often abstruse.

The Life of the Rook. By G. K. YEATES. (Philip Allan. 10*s.* 6*d.*).

Mr. Yeates is already known by the book *Bird Haunts in Wild Britain*, which he wrote in collaboration with Mr. Winnall. The present volume is a very interesting study at close quarters of a bird which is known to everyone. It does not pretend to be exhaustive, but is chiefly confined to the rook's breeding habits.

The author is a photographer, and a good bird-watcher as well. His investigations have been made from a hide in the tree-tops and not from the ground. They give rise to some intriguing speculations. He has much to say about "conjugal feeding"—a phrase borrowed from Mr. E. Selous. This feeding of the female by the male is, as he reminds us, a common feature in avian courtship, *e.g.*, with robins, greenfinches and common terns. The hen's ecstatic attitude during this proceeding suggests the young bird being fed by the parent. What, asks Mr. Yeates, is its meaning? He suggests that the female's thoughts are something like this:—"The gift of food is part of courtship: the end of courtship is mating: the result of mating is the chick. The swiftly changing mind of the bird . . . takes in at one glance the whole of the process; . . . for the moment in her own mind she has become the chick." Probably some such thought sequence does take place: a simpler explanation would be that the male's offer of food stimulates her memory of the time when she was fed as a nestling.

Mr. E. Selous has observed the mobbing of mating rooks by other occupants of the rookery; Mr. Yeates noticed that such mobbing occurred only occasionally, not invariably; sometimes the mating rite, which with rooks takes place on the nest, aroused no excitement in the neighbouring birds. Close-up examination and careful consideration of these phenomena convinced him that only an "illicit mating," *i.e.*, one forced upon a sitting hen by a male who was not her mate, caused the mobbing of the aggressor. The anger of the colony is aroused by promiscuity. The author admits that this view sounds too anthropomorphic, but his recorded observations bear out his conclusions. Possibly the peculiar cries of the outraged female are recognized as protests by her neighbours, and they come to her assistance.

The author gives a very graphic account of how the hen rook imparted to her mate the information that the eggs had hatched. His account of the episode is convincing: it was "perhaps the most human scene" he had ever beheld in the bird world. He thinks, and we agree, that man is inclined to belittle the emotions of "the lower orders." Another very "human" picture was that of the hen preening the cock's head and throat, after performing her own toilet; he is lucky to have witnessed so unusual a ceremony. Though the fertility of rooks' eggs is good, the infant mortality rate is very high. Mr. Yeates estimates that on the average not more than two young fly from each nest, and of these probably only one survives till the next season. As to the alleged necessity of shooting off young rooks in order to keep up the numbers of the rookery, he is rightly sceptical. This, like the oft repeated statement that flocks of feeding rooks throw out sentinels, he considers unproved.

The photographs are excellent. Mr. Yeates begs the photographer to spare the parent bird as much as possible, for "he is playing on one of the most sacred instincts—that of motherhood." Such a warning is both wise and necessary. We consider this book to be of definite importance. It is an attempt to study intensively the habits of one of our commonest birds, a branch of field ornithology that has hitherto often been neglected in favour of rarer species. Mr. Yeates has shown that it is possible to add greatly to our knowledge of the rook without being dull. We hope that in a subsequent edition he will make his work even more comprehensive, either by collating with his own the observations of others, or at any rate giving us the requisite authorities. And why do not authors of bird books always give us an index? Its absence often makes a book useless as a work of reference.

The World in Modern Science. By LEOPOLD INFELD. (Gollancz. 5*s.*).

Dr. Infeld, who is Reader in Theoretical Physics at Lwow University in Poland, has attempted the difficult task of giving intelligent laymen an insight into the problems of modern physics. His book is short—about one-third of the length of a novel—but the ground covered is great. He begins with an account of scientific method and a discussion of statistics and of determinism which, though intelligible to the informed, is too short and allusive for the ordinary reader. He then passes to a discussion of radiation and the quantum theory, and of the difficulties and paradoxes which arise from the quantum theory. The constitution of matter in terms of protons, electrons and atomic nuclei is next simply described. The two main sources of this information are then shortly discussed: the radioactivity which is spontaneous in nature and confined to the heaviest kinds of atom, and the artificial disintegration which is brought on in the laboratory and which, so far, has been successful with the lightest atoms only. Much of this must be new, or nearly new, to most readers, and it is described simply with the aid of apt illustration and telling analogy; it describes what is, in fact, one of the most remarkable and intelligent pieces of research in physics that has ever been done. The author then passes to the very striking phenomena which research in recent years has found to occur when matter and radiation interact: subjects like the X- and gamma-radiations and the "effects" associated with the names of Compton and Raman. Here again the author has taken pains to make the outlines of these difficult subjects clear by his analogies and illustrations. In the last chapter he attempts an exposition of quantum mechanics: the brave attempts of mathematical physicists such as de Broglie, Schrödinger, Heisenberg and Dirac, to get over the difficulties which the twentieth century revealed in nineteenth century physical dogma.

There is a tremendous lot in short compass in Dr. Infeld's

book; in fact, too much. The author's intentions are excellent, but it is doubtful if in this country there is a large class of readers for this book. The reader who has the capacity and the interest to absorb Dr. Infeld's writings is not one on whom the revelations of modern physics now burst for the first time. He has read about some of them before in the many popular accounts published in recent years in England. These have specialized in different parts of physics, have gone painstakingly to work, and in most cases have brought it off. Too hasty surveys, such as this book contains, will not impress those who have read the other books; on the other hand they are much too cryptic for beginners. Put in other words: there is no reader in England so interested in physics that he must be told so much as this book can tell him and yet so ignorant that it must be told to him in words of one syllable. This criticism, however, is criticism of the book as a whole. Parts of the book are excellent. The chapter on artificial atomic disintegration—work which at the present time is proceeding apace at Cambridge, in Paris, at Berkeley near San Francisco, and in other places—is the best. The work is still in a ripe experimental state, definite, concrete and outwardly simple to follow. It is new and, if scientific news ever can be topical, it is topical. Dr. Infeld's account is one of the first popular records of this in book form; it should serve as a good introduction to a subject which has this year gained fresh triumphs that do not, however, invalidate or render uninteresting what has already been achieved. The translation from the Polish, which has been done by Mr. Louis Infield, is excellent; there is no internal evidence anywhere that it is a translation.

The Naked Mountain. By ELIZABETH KNOWLTON. (Putnam. 21*s*.).

Many travel books, and some accounts of climbing, have been written by women; few can be classed as good literature. Miss Knowlton has written a book which, while satisfying the large public which is alleged to demand "adventurous narrative," will be welcomed by others as an addition of lasting value to the literature of mountaineering. The Naked Mountain is Nanga Parbat (26,630 feet) in the Western Himalaya, the highest peak there to be attacked by man. This is the story of an unsuccessful attempt by a German-American expedition to reach the summit. Miss Knowlton was the only woman and one of two Americans on the expedition, and she writes from first-hand knowledge of the dangers and difficulties which finally compelled the climbers to abandon the attempt.

There is a graphic chapter on the final stages of the attack. Towards the end of the afternoon the brightness of sure victory began to dim. The weather was going back on them; clouds were gathering in the west. Mournful and sick coolies came drifting in ones and twos to the sahib's tent. When the climbers opened their eyes next morning the tent was still in dark twilight. It was snowing! The snow must have been falling all night. It had piled so high already outside the tent. Still through the day it kept falling. They watched it hour after hour by the gap in the tent flaps—hurrying down through the thick air and heaping higher and higher. Every moment it seemed to bury more deeply their chance of success. That evening there was a discussion. It was brief. How could it be otherwise? There was really nothing left to discuss. It was finished. All night it snowed. They looked up at the sweep of whiteness that rose to the Rakiot Peak, and high against the blue, the ridge. There it all was, waiting, dazzling in the bright sunlight. Camp Five, Camp Six, Camp Seven, and beyond? . . . That was the way they should now be planning to go. Might it not still be possible, by sheer will, to conquer the impossible? Herron (one of the guides) faced towards the summit and began to struggle up the plateau. He did not advance ten feet. He floundered breathlessly in powder snow to the breast. He turned back. The others were laughing grimly at the ridiculous hopelessness of it all. They had been keyed to a desperate fight. There could not even be any fighting. No final heroic effort towards the summit to relieve the long pressure of desire. This was simply—the end.

Thus Miss Knowlton describes the attempt on the Naked Mountain, which must rank among the "glorious failures" in the history of mountaineering.

How to See Insects.

How to See Pond Life. By ERIC FITCH DAGLISH. (Dent. 2*s*. 6*d*. each).

We have always admired Mr. Daglish's woodcuts: he combines the subtle touch of the engraver with the accuracy of the naturalist; and while all his work is decorative in the best sense, his butterflies are really butterflies and his toads can be recognized. These handbooks on "How to See Nature" are Mr. Daglish at his best, and the latest additions to the series are well up to the standard set in his earlier volumes. In a little over a hundred pages the author succeeds in presenting an introduction to the study of insects which is entertaining and informative, if not exhaustive.

There is nothing more remarkable in insect life than the colonies of ants, wasps and bees. Writing of wasps, the author describes how the female builds the nest, rasping with her sharp jaws small pieces of old wood from posts, and by mixing the particles with saliva, producing a kind of papier mache, which we know as wasp paper. A thin layer of the material is plastered on top of the nesting chamber, and from this foundation a small pear-shaped structure, consisting of six-sided compartments is slowly built. An egg is laid in each compartment. The wasp next builds an umbrella-shaped covering of waterproof material two or three layers thick. This is constantly enlarged until it completely surrounds the comb, except for a small opening at the lower end. Mr. Daglish describes how the "workers" are hatched from the eggs laid by the "queen," who devotes her exclusive attention to laying; how new compartments are continually added to the nest as the colony increases at an incredible speed; how, as the nest grows in size, male wasps and other queens are reared in special "royal" cells, each becoming parents of large families which all remain in the same nest. Unlike the drone of the hive bee, the male wasp takes his share in the work of the colony, attending to the cleaning of the nest and removing the bodies of dead wasps.

Frogs and toads, newts and reptiles, fishes, water insects and water spiders, snails, shrimps and many other creatures which spend their lives at the bottom of still water are described in the book on pond life. Frogs and toads are often spoken of together as though they were so much alike as to be difficult to distinguish. In fact, they differ considerably in habits and structure, as Mr. Daglish points out. Everyone knows the obvious difference—that a frog hops while a toad crawls; but there are many more subtle distinctions which are often overlooked. The toad possesses a means of defence against its enemies which is not shared by the frog. At both sides of the head are glands containing a milk-like fluid which is given off

when the toad is alarmed and burns the mouth of an enemy.

The books are attractively produced; the type is in good taste and easy to read.

The California Deserts. By EDMUND C. JAEGER. (Oxford University Press. 9*s*.).

The deserts of California are not only much less extensive but also much younger than those of the Old World, and it is interesting to compare their resemblances and contrasts. The arid regions of Mohave and Colorado date only from the close of the Post-Pleistocene and there is still abundant evidence of recent moisture; conditions of humidity have fluctuated markedly and frequently. Lake Cahuilla, for instance, came into existence about the year 900 and disappeared as a lake about 600 years later, its former banks still being covered with remains of human occupation. There has consequently been great mobility of the latter, which has evolved a desert culture of its own, beginning in Arizona but with its centre in the favoured valley of the Colorado river. The chief cultural difference between the deserts of the New and Old Worlds seems to be in the absence from the former of beasts suitable for domestication and transport, such as the horse and the camel, which have so profoundly influenced history in Asia and Africa. The Yuma and Shoshone Indians could therefore never develop a culture like that of the Tartars or Arabs. A remarkable coincidence is the occurrence and appreciation in both of turquoise, which was mined in California on quite a substantial scale with stone implements. We find also an early development of great trade routes, running east by west, by which the Mohave Indians brought sea shells and marine produce to exchange with the Pueblos for pottery and pigments.

The frontispiece from Williamson's "Peregrine's Saga" (Putnam) reviewed last month.

Both fauna and flora are surprisingly rich. There are seventy-five species and sub-species of mammals, of which two-thirds are rodents. The outstanding member is the bighorn sheep, now reduced to some five or six hundred individuals. Among invertebrates, many kinds of millipedes have survived the reduction of vegetation. Mollusca give valuable evidence about routes of migration and of physiography by tracing the evolution due to isolation. Pale lizards of lightning-like activity remind the traveller of Central Asia, and the cruel and violent gales recall the Gobi; but unlike Asia these deserts are most attractive in winter. California has no less than 700 species of flowering plants, being fortunate in drawing upon two sources. While a number of Holarctic genera are represented, many familiar in Europe and the plains of Asia are recalled by *Prosopis*, *Ephedra*, *Stipa*, *Artemisia*, *Celtis*, *Acacia* and others. The xerophytic flora of the Sonora plateau of Mexico has given a wealth of yuccas, cacti (twenty-one species) and other succulents. It is surprising that the arid region has succeeded in retaining twelve species of ferns and thirty-three of grasses, some affording valuable fodder for transport animals. Lichens, though few in species, are numerous and there is abundance of fungi, some apparently the same as in the Sahara. The dominant type of plant is grey and hairy. The glassworts and saxauls of Asia are replaced by the burro weed (*Frasneria*) and creosote bush (*Larria tridentata*), the latter indicating the most desert places, occurring with amazingly regular spacing. They can survive thirty-two months desiccation.

As in all arid regions, desert patina or sunburn is characteristic. Here it is found even in embedded rocks of Eocene age. It was attributed to the reducing action of the sun's rays upon ferrous salts, but there is now a tendency to explain it by the action of old lichens. It is unfortunate that the rate of deposition has not yet been measured, as here it is found on old artefacts, as in Asia it is found on ancient monuments.

Unexpected details arise—that, for instance, the San Andreas Rift is probably longer even than the East African Rift. It is also curious that the common English sparrow, presumably *Passer domesticus*, has followed man from home even here, where it is confined to the immediate neighbourhood of human habitations, just as it is in the north of Siberia.

Secrets of the Red Sea. By HENRY DE MONFRIED. (Faber & Faber. 12*s*. 6*d*.).

M. de Monfried has spent twenty years in the Red Sea, on a sailing boat which he built himself and manned with a native crew. He is described by the publishers as an "individualist at odds with civilization"; which puts the case mildly. In the course of his unconventional life afloat the author has engaged in pearl fishing, smuggling and gun-running, and it is no surprise that he found himself on many occasions in trouble with the authorities. The book is useful for the light which it throws on the lives and habits of the Arabs and Africans who inhabit the shores of the Red Sea. Of these the author writes with unusual intimacy. As a story of adventure the book would be hard to beat.

New Guinea Recollections. By C. A. W. Monckton. (John Lane. 8*s*. 6*d*.).

The recollections of government servants in the Empire are always interesting and sometimes valuable; often they shed an unexpectedly useful light on anthropological problems. Mr. Monckton was for some years a resident magistrate in New Guinea and is already the author of two similar books. His latest recollections, of events in New Guinea many years ago, are entertaining if not of the first importance from an anthropological point of view. Their chief interest for the reader to-day is, perhaps, in the emphasis which this book lays on the

change which has taken place in New Guinea (and elsewhere) as a result of scientific invention. Cannibalism, head-hunting and savage inter-tribal warfare are still pursued in the more remote regions; but aeroplanes, motor launches, wireless and regular steam communication have vastly altered the country. Many of the natives, including the constabulary, can now read and write, and as Mr. Monckton naively remarks, they now enjoy the benefit of taxation. And it is no longer possible for an officer with a small detachment of constabulary to disappear for months at a time, or to be abandoned by his superiors for a like period.

Mr. Monckton has many adventurous episodes to relate which he does in a racy and practiced way.

Arctic Village. By ROBERT MARSHALL. (Jarrolds. 18s.).

Mr. Marshall's observant and sympathetic account of life in Arctic Alaska emphasizes what has so often been said of the Eskimo peoples: they are probably the most contented, the most honourable and the most hospitable people in the world. The author is an American who spent a year in the region about the headwaters of the Koyukuk river, north of the Arctic Circle. Civilization here is composed of a mixture of white men and Eskimos; their chief occupations are gold-mining, hunting, trapping and wood-cutting; and Mr. Marshall explains that their language is English, though this fact might escape the notice of a less enthusiastic visitor—"Fish on top, no good, give him to dog. Fish on bottom, not so rotten, no need him cook, eat him up." The author describes in some detail the dress and diet of his Arctic friends, and there are illuminating chapters on the economic and social structure of their society. They have no chiefs nor tribal councils; their conduct is controlled entirely by personal contacts with their neighbours and by voluntary taboos. During the past thirty years considerable wealth has been produced in the Koyukuk, yet there has never been a large theft or robbery and only three murders have been committed, one by a man who was mentally deranged and the others by a prospector whom three men attempted with violence to drive from his claim.

Mr. Marshall's recollections are vivid and detailed and tell us much about a little-known and isolated people; but his style lacks dignity and finish, and the book is inordinately long. The illustrations are first-rate.

The Script of Harappa and Mohenjodaro. And its Connection with Other Scripts. By G. R. HUNTER. With an Introduction by PROFESSOR S. LANGDON. Studies in the History of Culture. No. 1. (Kegan Paul. 21s.).

The existence of the script with which this volume deals has been known for more than half a century, but texts were only forthcoming in any number when the Government of India took in hand the systematic excavation of the ancient sites at Harappa and Mohenjodaro. As the author points out, even the texts which have now been discovered are short and are mainly confined to engravings on seals. But they are now sufficiently numerous to justify this valuable correlation and classification. Thirty-eight plates in the book indicate the extent of the discoveries of inscribed objects found up to the close of the excavating season (February, 1927); and they reproduce all the script at present possessed with the exception of some which have already been published elsewhere.

Mr. Hunter explains the distinctiveness of the Mohenjodaro and Harappa script; it is neither Sumerian nor any other known script, though it bears certain resemblances to several. The author says that it would be rash at present to rule out of court the hypothesis of a common descent from some remote ancestor for the script of Harappa and any other pictographic script. After all we know so little of the ultimate pictographic ancestry of any script, even Sumerian. Mr. Hunter does not think it likely that the originators of the script were Aryans, since they are not believed to have entered India before 1200 B.C. at the earliest, whereas the script has been proved to exist many centuries before that date. It is probable that the Indus Valley was inhabited by Dravidians before the arrival of the Aryans; but this is not certain, nor would it exclude the possibility of a riverine or maritime folk of a different race being responsible for Mohenjodaro or Harappa—a seafaring race foreign to India into which they had penetrated up the navigable Indus and its affluents. Were these people the Phoenicians of the East? There are times, Mr. Hunter suggests, when one is almost tempted to credit the legend of a lost Atlantis (placing it, however, rather in the Pacific and round Easter Island than the Atlantic) and to wonder whether there, in early times, there did not arise a Neolithic civilization and Neolithic script which, spreading thence west and east overseas, was the ultimate parent alike of Central American and Indo-Sumerian civilization.

British Airways. By C. ST. JOHN SPRIGG.

The Young Chemist. By F. SHERWOOD TAYLOR. (Nelson: "Discovery Books." 2s. 6d. each).

These two volumes introduce a new series which, while particularly suitable for younger readers, will be read with interest and instruction by those who are older. Mr. St. John Sprigg shows how the development of air transport is bringing together parts of the Empire which before its coming were separated by many weeks. In Australia, India and Africa there are large tracts where there is no form of transport, no rivers, roads or railways. In such regions as these the 'plane does in two of three hours a journey that would take weeks or months of toil through the jungle or trek across the desert. Mr. Sprigg describes the way in which the Empire air routes operate and deals in detail, though not in technical language, with the construction of the machines themselves, the aerodromes and the methods of working.

Dr. Taylor presents full instructions for many chemical experiments which may be conducted in the home cheaply and easily, and (as many people will be grateful to know) without danger. The author succeeded in choosing experiments which are interesting and various; and the diagrams provided by Mr. L. R. Brightwell are a great assistance to the text. The "Discovery Books" deserve to be successful. They are most attractively produced.

From Moscow to Samarkand. By "Y.Z." (Hogarth Press. 6s.).

The author is a Russian who prefers to remain anonymous. His style is satisfying and he gives a faithful picture of the country. But his work is subjective rather than objective. The book is a pleasing, but hardly important, addition to the substantial literature on this part of the world. The author understands the native mind and his impression of the Uzbeks, more familiarly if less correctly known as Sarts, agrees with that of men who have spent their lives among them.